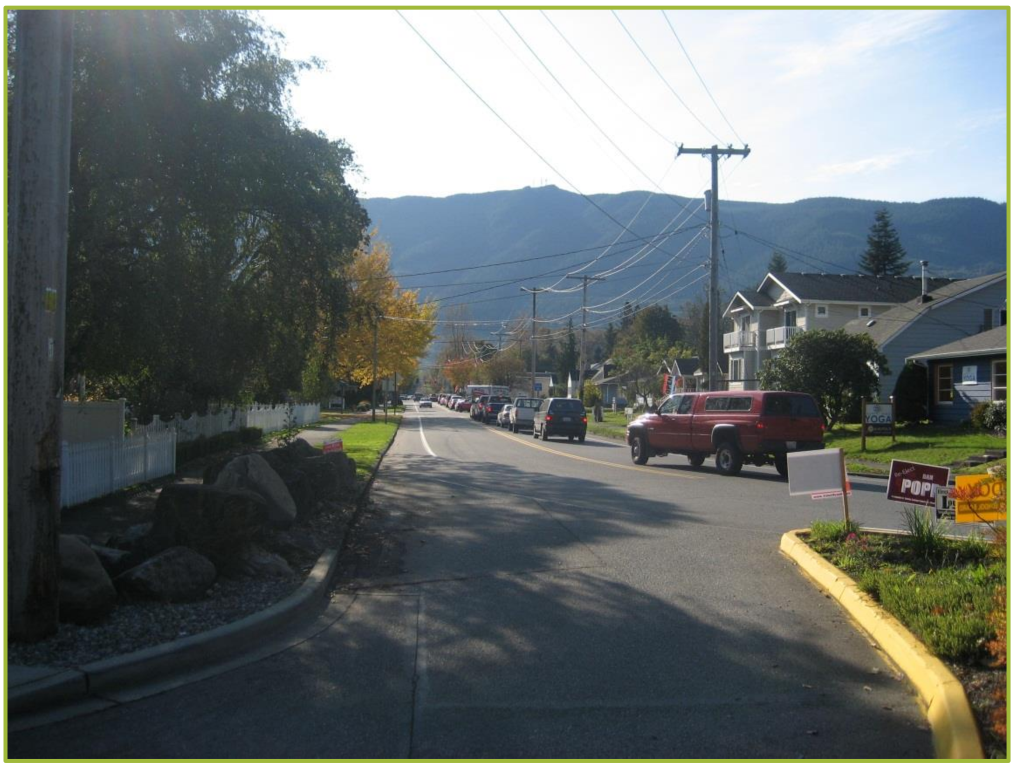
City of North Bend

Transportation Element Update

Final Report

October 2012



Chapter 4 – Transportation Element
Adopted October 16, 2012 – Ordinance 1467

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City of North Bend

Comprehensive Plan - Transportation Element Update

Final Report

June 2012

Mayor

Ken Hearing

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Chapter 1: Introduction

The Transportation Element of the City of North Bend Comprehensive Plan establishes a framework for providing a multi-modal transportation system of facilities and services to support the projected growth of land use within the City and its designated Urban Growth Area in East King County. The Transportation Element framework is consistent with Transportation 2040, the adopted long range plan of the Puget Sound Regional Council, and King County plans and policies. It meets the mandatory requirements of the Washington State Growth Management Act (GMA) under RCW 36.70A.070 and it provides transportation project recommendations for inclusion in the City's Capital Facilities Plan.

The vision of the Transportation Element is a safe, dependable, properly maintained, fiscally and environmentally sustainable multi-modal transportation system that is consistent with and supports the other elements of the Comprehensive Plan. The transportation system should respect community character, environment, and neighborhoods; improve mobility and safety; support economic vitality; minimize impacts from regional facilities; and promote increased use of transit and non-motorized travel. The transportation system needs to be both locally and regionally coordinated, adequately financed, and community supported.

The updated Transportation Element reflects the creation of a Transportation Benefit District (Proposition 1, passed by city voters in November 2011 to add a two-tenths of one percent (0.2%) city sales and use tax dedicated to transportation improvements) which will help to fund transportation facilities needed to support a vital economy and keep pace with the City's growth and development. The policy direction within this element and the project recommendations also provide for the improvement of facilities for walking and bicycling, and recognize the mobility benefits provided by King County Metro Transit within the bus service area. The objective of these policies and actions is to reduce automobile dependence, thereby minimizing the need for capital-intensive street capacity expansion, while improving conditions for moving about safely and conveniently without a car.

North Bend is a small but growing city in King County that is located east of Seattle, along the Interstate 90 (I-90) corridor in the Snoqualmie Valley between Mount Si and Rattlesnake Ridge. The City is nearly surrounded by the South and Middle Forks of the Snoqualmie River and lies near large tracts of county, state, and federal forests and parklands. North Bend's local park and recreation facilities serve residents within the City limits, as well as the City's Urban Growth Area (UGA) and the Upper Snoqualmie Valley. The City also serves as an important stopover point for regional and national tourists traveling on I-90.

Figure 1 shows the study area that is included in the computerized traffic model that serves as a basis for many of the recommendations in this plan. The extent of the study area depicted in Figure 1 includes the City limits and the UGA.

PURPOSE OF PLAN UPDATE

The purpose of the City of North Bend Transportation Element is to identify, evaluate and recommend transportation improvements for the City through the planning horizon of 2030. It provides a vision for the City's transportation system in 2030 and it is intended to guide the development of that system by the City and other responsible stakeholders.

The Transportation Element is an integral part of the City's Comprehensive Plan. It is required to satisfy GMA requirements that call for a balanced approach to land use and transportation planning, ensuring that the City's transportation system can support planned levels of land use development. The City has adopted level of service (LOS) standards for the transportation system as required, to provide a policy framework for maintaining the community's desired quality of life while it develops and changes over time.

In addition, the GMA mandates that capital facility funds be identified to pay for necessary transportation improvements. The Transportation Element identifies several sources to finance the recommended transportation projects, including the City's new Transportation Benefit District as identified above. It provides documentation to support grant applications by the City to fund needed improvement projects.

The Transportation Element includes the transportation goals and policies, as prepared for the Comprehensive Plan, adopted on May 16, 1995, and updated in 2003 and 2012. This plan includes goals, objectives and policies from other communities in the Northwest and amended and refined by City staff, elected officials and the community over time.

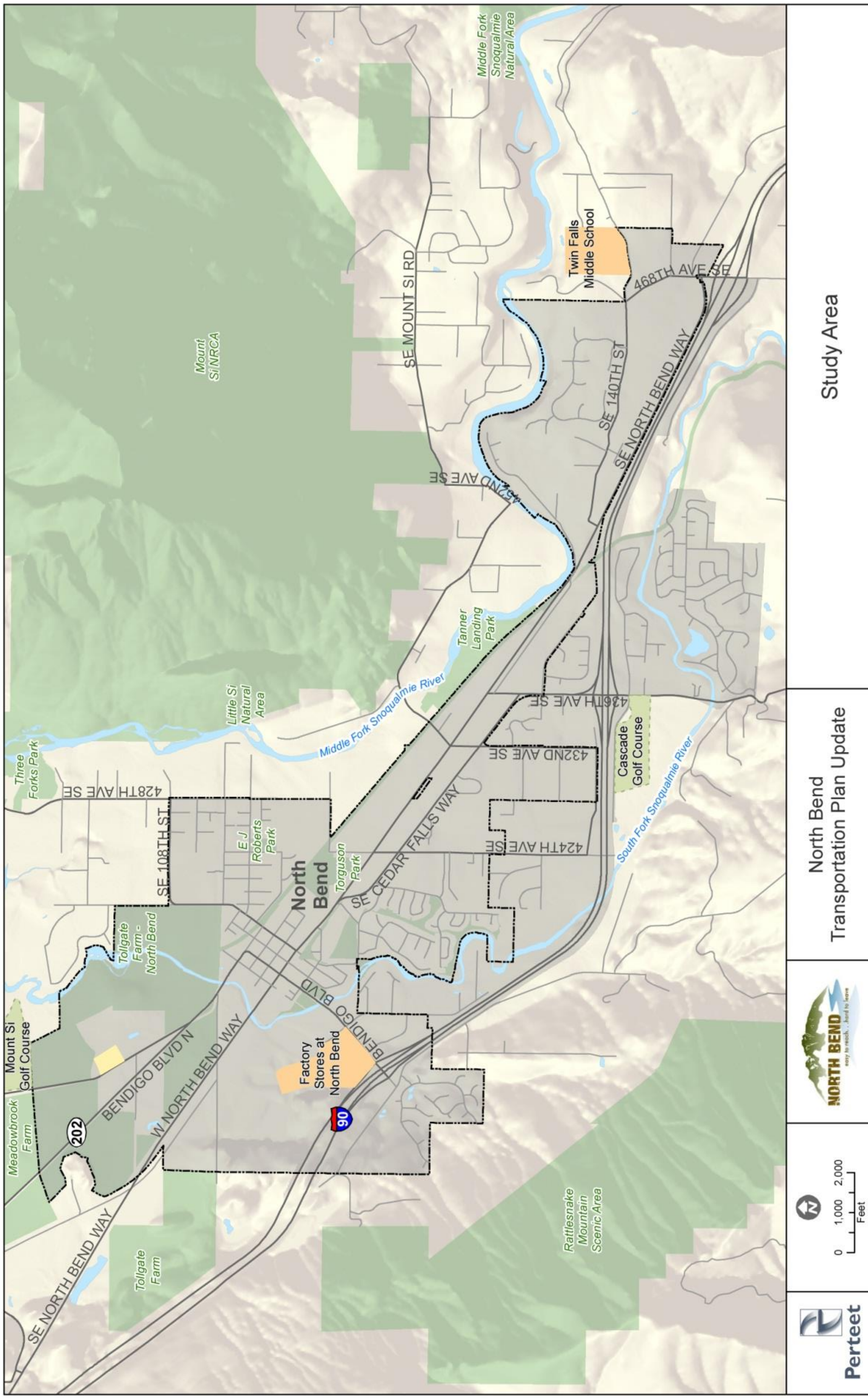
It is almost inevitable that some conflict will arise between a transportation policy and real-world constraints and opportunities, or even between two policies. After the specifics of the situation and the purpose of the policies are fully understood, the conflict should be resolved using the best judgment of the City Council, as advised by City Staff. However, it is of utmost importance that the transportation policies be applied consistently to every development proposal. If a policy cannot be consistently followed, the policy should be modified or replaced prior to the approval of a development request.

THE GROWTH MANAGEMENT ACT

Transportation planning at the State, County and local levels is mandated by the WA State *Growth Management Act* (GMA) [RCW 36.70A, 1990]. The GMA contains many requirements for the preparation of a transportation element the most important being consistency with the land use element. Specific GMA requirements for a transportation element include:

- Inventory of facilities by mode of transport;
- Level of Service calculations to aid in determining the existing and future operating conditions of the facilities;
- Proposed actions to bring these deficient facilities into compliance;
- Forecasts of traffic based on land use;
- Identification of future infrastructure needs to meet current and future demands;
- Funding analysis for needed improvements as well as possible additional funding sources;
- Identification of intergovernmental coordination efforts; and
- Identification of demand-management strategies as available.

FIGURE 1: NORTH BEND TRANSPORTATION STUDY AREA



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In addition to the above the GMA also states that development cannot occur unless existing infrastructure either exists or is built concurrent with development (within six years). This infrastructure could include: additional transit service, travel demand management strategies (e.g., ridesharing, etc.), and other transportation system management strategies as well as the possibility of construction of new facilities when necessary.

Puget Sound Regional Council Vision 2040/Transportation 2040

In April 2008 the PSRC adopted a long range regional growth strategy for the central Puget Sound region to accommodate a projected increase of 2.7 million people by 2040. Local jurisdiction comprehensive plans such as North Bend's must be reviewed and certified for consistency with the regional plan in order to maintain eligibility for funding from regional, state and/or federal agencies. A checklist has been provided by PSRC as a local jurisdiction comprehensive plan reporting tool, to guide plan certification. The transportation-related checklist items are provided below:

<u>Maintenance, Management and Safety</u>

- Clean transportation programs and facilities, including actions to reduce pollution and greenhouse gas emissions from transportation
- Incorporate environmental factors into transportation decision-making, including attention to human health and safety
- Identify stable and predictable funding sources for maintaining and preserving existing transportation facilities and service
- Include transportation systems management and demand management programs and strategies
- Identify transportation programs and strategies for security and emergency responses

<u>Supporting the Growth Strategy</u>

- Focus system improvements to support existing and planned development as allocated by the *Regional Growth Strategy*
- Prioritize investments in centers
- Invest in and promote joint- and mixed-use development
- Include complete streets provisions and improve local street patterns for walking and biking
- Design transportation facilities to fit the community in which they are located ("context sensitive design"); use urban design principles when developing and operating transportation facilities in cities and urban areas

<u>Greater Options and Mobility</u>

- Invest in alternatives to driving alone
- Ensure mobility of people with special needs
- Avoid new or expanded facilities in rural areas
- Include transportation financing methods that sustain maintenance, preservation, and operations of facilities

Linking Land Use and Transportation

- Integrate the ten Transportation 2040 physical design guidelines in planning for centers and high-capacity transit station areas
- Use land use development tools and practices that support alternatives to driving alone – including walking, biking and transit use

Land Use Assumptions and Forecast of Travel Demand

- Demonstrate that travel demand forecasts and transportation need assessments are always based on land use assumptions that correspond with the most recently adopted growth targets; ensure that population and employment assumptions are consistent throughout the comprehensive plan

Service and Facility Needs – Including Level-of-Service Standards and Concurrency

- Include inventories for each transportation system, including roadways, transit, cycling, walking, freight, airports, and ferries
- Establish level-of-service standards that promote optimal movement of people across multiple transportation modes
- Include state facilities and reflect related level-of-service standards
- Address multiple transportation modes in concurrency programs
- Tailor concurrency programs, especially for centers, to encourage development that can be supported by transit

Financing and Investments – including Reassessment Strategy

- Include a multi-year financing plan, as well as an analysis of funding capability
- Include a reassessment strategy to address the event of a funding shortfall

Intergovernmental Coordination

- Coordinate with neighboring cities, the county, regional agencies and the state

Demand Management

- Identify demand management strategies and actions, including but not limited to programs to implement the Commute Trip Reduction Act

Pedestrian and Bicycle Component

- Include strategies, programs and projects that address non-motorized travel as a safe and efficient transportation option – including pedestrian and bicycle planning, project funding and capital investments, education and safety.

KING COUNTYWIDE PLANNING PROCESS

In response to the GMA mandates for regional coordination for growth, King County adopted policies to provide guidelines for regional cooperative growth management planning. The King County Countywide Planning Policies (CWPP) are directed at providing a balanced transportation system using all modes of transportation (e.g., automobiles, heavy vehicles, transit, bicycle, pedestrian, equestrian, air travel, etc.) as efficiently as possible. The policies direct that impacts to individual cities related to the movement of people and goods generated by State, County, and/ or neighboring jurisdictions must be taken into account. The policies further require that jurisdictions coordinate with one another in the planning, financing and implementation of land use plans to minimize impacts on neighboring jurisdictions.

All interested parties (e.g., State, County, Metropolitan Planning Organizations, Puget Sound Regional Council, and neighboring jurisdictions) as well as transit operators, airport officials, etc., should work together to provide a region-wide transportation system.

Future improvement needs for all modes of transportation should be considered and included in the Plan with particular emphasis placed on completing the regional systems. Additionally, Level of Service (LOS) calculations should be consistent to aid in determining accountability and impacts of projects. Mode-split goals for each mode of transportation should be determined to ensure services are adequate.

The CWPP also specifies that timelines for all improvements are to be identified, focusing on maintenance and preservation of existing infrastructure with additions as necessary to accommodate future growth. Further, when funding falls short of projected need, alternative funding sources should be sought including developer contributions, impact fees, LID's, etc. Consistency of plans, projects, and thresholds with regional, state, and neighboring jurisdictions should also be considered.

OBJECTIVES OF PLAN

Based upon the directives of the City's adopted transportation goals and policies, as well as the mandates of the GMA and the King County CWPP, the objectives for the *City of North Bend Transportation Plan* are as follows:

- Address the total transportation needs of the City of North Bend.
- Identify transportation improvements necessary to provide a system that will function safely and efficiently through the year 2030.
- Ensure consistency with the land use of local comprehensive plans.
- Provide an efficient transportation system.
- Contribute to economic growth.
- Provide cost-effective accessibility for people, goods, and services.
- Provide travel alternatives that are safe and have convenient access to employment, education, and recreational opportunities for urban and suburban residents in the area.
- Identify funding needs for planned transportation improvements and the appropriate participation by both the public and private sectors of the local economy.

- Comply with the requirements of The Growth Management Act and the Washington State Environmental Policy Act (SEPA).

COMMUNITY INVOLVEMENT

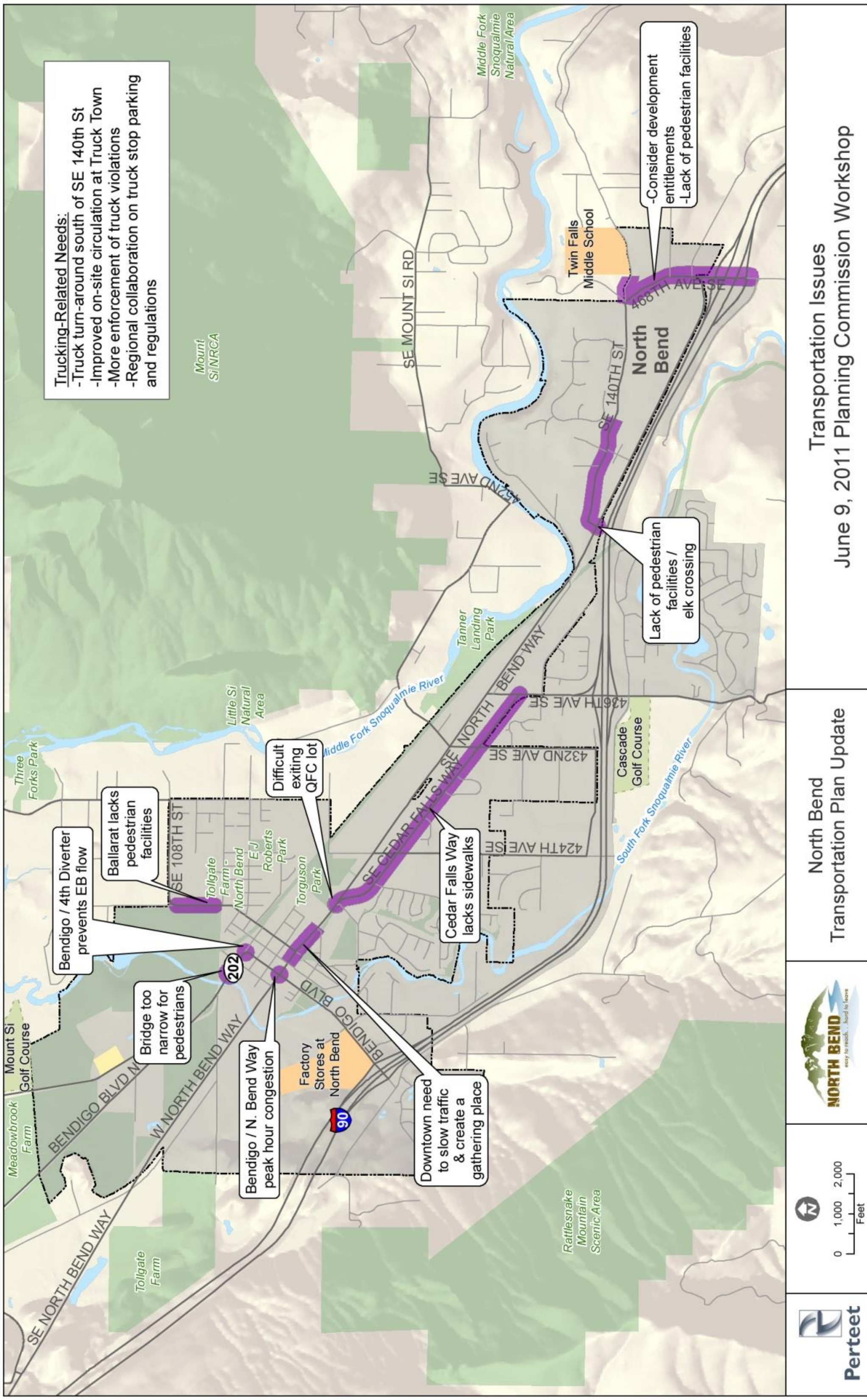
The *City of North Bend Transportation Element* is the product of community involvement at all stages of the planning and development process.

Transportation Plan Update

For the 2003 update of the Transportation Plan, the City implemented a community involvement strategy that included Public Open Houses and the formation of a Technical Advisory Committee (TAC). For the 2012 update the City implemented a similar community involvement strategy. The Planning Commission acted as the Technical Review Committee and hosted several public workshops during the plan update process during 2011 and early 2012. A number of transportation concerns were identified, as shown in Figure 2: June 9, 2011 Planning Commission Workshop. Issues identified included:

- Congested peak hour traffic conditions at the intersection of North Bend Way and Bendigo Boulevard;
- The need to modify the traffic diverter at Bendigo Boulevard/NE 4th Street to allow eastbound traffic movements, relieving the North Bend Way and Bendigo intersection, pending design analysis a roundabout would be preferred;
- The need to slow traffic on North Bend Way in Downtown North Bend to create a more attractive and pedestrian-friendly gathering place;
- The need for improved pedestrian facilities at the Bendigo bridge over the South Fork, along Ballarat between NE 8th and NE 12th Streets, along SE Cedar Falls Way, 468th Avenue SE, the western part of SE 140th Street; and
- Trucking-related needs, especially on 468th Avenue SE and in the vicinity, including the need for a truck turn-around south of SE 140th Street, the need for improved on-site circulation at Truck Town, more enforcement of truck violations, and regional collaboration to increase truck stop parking and attention to regulatory needs.

FIGURE 2: TRANSPORTATION ISSUES, JUNE 9, 2011 PLANNING COMMISSION WORKSHOP



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OVERVIEW OF PLAN

The City of North Bend Transportation Plan is presented in the following chapters, which include the Plan elements as described:

Chapter 1 – Introduction. This chapter has described the purpose of the Transportation Plan Update, the regulatory environment which the plan must satisfy, and the community process.

Chapter 2 – Goals, Objectives and Policies. This chapter presents the transportation policy framework that the City will utilize to plan, construct, operate and maintain the transportation system within the City of North Bend.

Chapter 3 – Transportation Inventory. This chapter describes the transportation and land use efforts with which this plan has been coordinated, provides an inventory of the elements of the current transportation system, and presents the existing adopted transportation improvement plan.

Chapter 4– Roadway Conditions and Level-of-Service. This chapter describes the level-of-service criteria for the roadway system and assesses the operational elements of the existing road network.

Chapter 5–Traffic Forecast Model Summary. This chapter presents the methodology used to forecast transportation conditions through the 2030 planning horizon, and provides an assessment of future traffic conditions if no additional improvements are made to the transportation system.

Chapter 6 – System Analysis. This chapter provides a summary of the existing and future transportation issues that must be addressed, and presents potential improvements to address existing and anticipated future deficiencies in the system.

Chapter 7 – Recommended Plan. Finally, this chapter describes the transportation plan recommended to address deficiencies in the transportation system now and through the 2030 planning horizon while meeting fiscal and other constraints. This chapter also presents the financing and concurrency elements of the Transportation Plan.

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Chapter 2: Goals, Objectives and Policies

The purpose of the Goals, Objectives and Policies chapter of the Transportation Element is to guide the development of transportation facilities and services in North Bend in a manner consistent with the overall goals of the Comprehensive Plan. The Transportation Element addresses street classifications, levels of service, travel forecasts, travel improvements, alternative modes, funding strategies, and concurrency management. It is based upon current and projected land use and travel patterns, and addresses both local and State transportation facilities. The Transportation Element also provides direction for establishing regulations governing transportation systems, and for developing guidelines for facilities and improvement programs aimed at improving North Bend's transportation system.

The Transportation Element of the North Bend Comprehensive Plan includes transportation goals and policies, as prepared for the Comprehensive Plan, adopted on May 16, 1995, and as updated in 2003 and 2012.

Following the adoption of a set of transportation policies intended to serve as a roadmap to an efficient transportation system, it is almost inevitable that some conflict will arise between a transportation policy and real-world constraints and opportunities, or even between two policies. It is of the utmost importance that the transportation policies be applied consistently to every development proposal. When conflicts arise, consideration of the specific situation and with advice by City staff, the conflict should be resolved using the best judgment of the City Council.

The Goals, Objectives and Policies of the Transportation Plan Element play a central role in plan implementation. The following definitions are intended to provide guidance as to the purpose of "Goals," "Policies," and "Objectives."

Goal: Goals are broad, general statements of the desired long-term future state towards which the Plan aims. They indicate what ought to exist in a community or what is desired to be achieved in the future. In other words, Goals articulate the preferred vision for the future.

Objective: Objectives are statements of the desired short-term and more measurable aims of the Plan; the objectives articulate how a goal will be achieved.

Policy: A policy describes a specific course of action or method that should be used to accomplish the purposes of the Transportation Element. Policies are decision-oriented statements which guide the Mayor, City Council, Planning Commission, and staff in their efforts to evaluate new projects, proposed changes to adopted ordinances, or other initiatives affecting the transportation within the City of North Bend.

In summary, goals are value-based statements that are hard to measure. Objectives state more specifically how a particular goal will be pursued. Policies help guide the review of development applications, and also help guide the City Council in adopting ordinances or preparing budgets.

For the purposes of the North Bend Transportation Element, the policies often use "should" rather than shall. The word "shall" would then be used in implementing ordinances or codes.

In this section, goals, objectives and policies are defined under the following major categories:

- Goal 1 - Streets and Highways
- Goal 2 - Environmental Quality
- Goal 3 - Pedestrian and Bicycle Transportation
- Goal 4 - Public Transportation
- Goal 5 - Streetscape
- Goal 6 - Capital Facilities

STREETS AND HIGHWAYS

Goal 1: Develop a multi-modal transportation system that is consistent with the land use element of the Comprehensive Plan that preserves and enhances the livability of North Bend and the Upper Snoqualmie Valley.

Objective 1.1: *For transportation facilities which primarily benefit non-North Bend residents, local community standards must be adhered to in accordance with the following policies:*

Policy 1.1.1: Streets and highways should be located and designed to meet the demands of both existing and projected land uses as provided for in the North Bend Comprehensive Plan.

Policy 1.1.4: Safe and efficient movement of pedestrian and bicycle traffic throughout North Bend, especially in school and recreational areas, and the downtown should be provided.

Policy 1.1.5: Whenever another governmental agency causes additional transportation impacts or costs to the City of North Bend, the City shall charge mitigation fees to defray any costs not mitigated by any additional benefits accruing to the City as a result of the other government agency's transportation-related actions. The City should develop reciprocal concurrency agreements with adjacent jurisdictions to facilitate the collection of mitigation fees or construction of needed improvements to impacted intersections.

Policy 1.1.8: Integrate economic development factors into long-range transportation planning.

Objective 1.2: *Streets should be located, connected, designed and improved in a manner that will conserve land, materials and energy.*

Policy 1.2.1: Streets should be designed with the minimum pavement areas required in order to reduce impermeable surfaces, consistent with current AASHTO safety standards.

Policy 1.2.2: Future street construction shall provide transportation alternatives for pedestrians and bicycles consistent with the North Bend Park & Open Space Plan and encourage conservation of energy.

Policy 1.2.3: Collector and arterial streets should be designed to accommodate public transportation, bicycles, and truck access.

Objective 1.3: *Design standards for streets should provide reasonable guidance for the development of streets that are safe, functionally efficient, aesthetically pleasing, and cost effective. All new transportation improvements should be scaled to the function they are designed to perform in conformance to the density and land uses they serve. The following policies should provide guidance for the design of new transportation improvements:*

Policy 1.3.4: Adequate, but not excessive on-street parking should be encouraged on commercial and residential streets where it can be safely accommodated.

Policy 1.3.5: Streets should be designed to accommodate vehicles that use the street most frequently rather than for large vehicles which may use the street only occasionally.

Policy 1.3.6: Required street widths should be related to the function and level of service standards for the street, while reducing impervious surface to the maximum degree feasible.

Policy 1.3.7: Residential streets should be designed to preserve existing trees and vegetation.

Policy 1.3.8: Landscaping should be utilized to provide visual and physical barriers but should be carefully designed not to interfere with visibility and traffic safety.

Policy 1.3.9: Subject to available funding, undergrounding of existing overhead utilities should be explored and encouraged at the time of street improvement through the establishment of U.L.I.D.'s. Utilities shall continue to be underground for all new construction.

Policy 1.3.10: Circulation from private property to the public street system should be designed in a manner that provides a safe and convenient access system that respects community needs and values.

(a) For safety reasons, limit and provide access to the street network in a manner consistent with the function and purpose of each roadway. Require the preparation of comprehensive access plans and consolidation of access points in commercial and high density residential areas through shared driveways and local access streets.

(b) Require new development to minimize and consolidate access points along all principal and minor arterial streets, but especially along state routes and arterial streets.

(c) Place a high priority on consolidating existing driveways onto all arterial streets. This effort should be coordinated with local business and property owners in conjunction with improvements to the arterial system and redevelopment of adjacent land parcels.

(d) Develop and utilize minor access streets as the primary means of providing access to residential areas.

(e) Access onto state highways shall be regulated according to RCW 47.50.

Objective 1.4: *Circulation through the City of North Bend should be primarily via the system of collector and arterial streets, bicycle and pedestrian paths.*

Policy 1.4.1: The City of North Bend will encourage the efficient movement of people and goods through an effective and inter-connected collector and arterial street system that protects sensitive areas including wetlands, riparian corridors, floodways, and channel migration zones.

Policy 1.4.2 To minimize trip distances and maximize pedestrian and bicycle mobility, ensure that future developments are interconnected, with multiple access points into and between neighborhoods.

Policy 1.4.3: Vehicular and pedestrian connectivity between neighborhoods shall be a priority. The use of dead end streets and cul-de-sacs should be avoided. When unavoidable, the length of a dead end street, including cul-de-sac, should be limited.

Objective 1.5: *Improve traffic safety and reduce congestion through appropriate street design and site layout during the development process.*

Policy 1.5.1: New development shall be required to dedicate and improve street rights-of-way for private and public streets as specified by City Standards and the Transportation Element of the Comprehensive Plan.

Policy 1.5.3: In some cases, such as for the installation of sidewalks, the City may acquire easements and/ or development rights in lieu of rights-of-way.

Policy 1.5.4 Cooperate with the WSDOT and other regional agencies (including the Port of Seattle) as appropriate to increase the supply of off-street facilities for overnight truck parking along the I-90 corridor.

Policy 1.5.5: Cooperate with the WSDOT and King County to plan for, and efficiently manage spillover truck parking demand due to emergency closures of I-90, especially in winter months.

Objective 1.6: *Plan, develop, and maintain transportation systems that are consistent with The City of Snoqualmie, King County, the Snoqualmie Valley School District, the Si View Metropolitan Park District, and the state.*

Policy 1.6.1: Participate in local and regional forums to coordinate strategies and programs that further the goals of the Comprehensive Plan and implement the Transportation Element.

Policy 1.6.2: Work with neighboring jurisdictions and regional and state agencies to coordinate transportation system improvements and assure that funding requirements are met.

Objective 1.7: *Document citizen requests concerning traffic calming and develop an annual process to prioritize them for corrective actions.*

Policy 1.7.1: Preserve the neighborhood environment through use of traffic calming techniques.

Objective 1.8: *Provide a designated system of roadways that provide reliable truck mobility through the City, and to/from the growing number of businesses in the City, while minimizing negative community aspects.*

Policy 1.8.1: The City recognizes that the safe and efficient movement of freight is vital to the economic viability and success of businesses located in North Bend. Given that fact, consider the movement of freight in the design, operations and maintenance of the City's transportation system.

Policy 1.8.2: Designate two types of truck routes on the City's arterial and collector streets: a) Through Truck Routes, principally on arterial streets – for movements through the City, and b) Truck Access Route, principally on collector streets – for movements between the Through Truck Routes and freight destinations within the City. Through Truck Routes will include I-90 and Bendigo Boulevard/SR-202.

Policy 1.8.3: On designated truck routes, give design consideration to the additional requirements of truck weight, turning radius requirements, and slower travel speed relative to the construction of pavements, intersections and traffic signals.

Policy 1.8.4: Restrict truck parking in residential neighborhoods.

ENVIRONMENTAL QUALITY

Goal 2: Develop public and private transportation improvements that minimize adverse impacts on the natural environment, air and water quality, public health and energy consumption, and support healthful mobility options including walking and biking.

Objective 2.1: *Comply with federal and state air quality requirements related to the North Bend transportation system, including the law passed by the State Legislature in 2008 that establishes a statewide goal to reduce greenhouse gas emissions to 1990 levels by 2020; to 25% below 1990 levels by 2035; and to 50% below 1990 levels by 2050.*

Policy 2.1.1: Participate in efforts by the State and Puget Sound agencies to improve air quality as it is affected by the movement of people and goods.

Policy 2.1.2: Conform to the Federal and State Clean Air Acts by maintaining conformity with the long range regional growth strategy of the Puget Sound Regional Council as documented in its Vision 2040 and Transportation 2040 plans, and by following the requirements of Chapter 173-420 of the Washington Administrative Code, the Washington State Clean Air Conformity Act, with which local transportation plans and transportation improvement programs must comply.

Policy 2.1.3: Work with the Puget Sound Regional Council, WSDOT and other agencies and jurisdictions in the development of transportation control measures and air quality programs where warranted.

Objective 2.2: *Reduce the adverse environmental and health impacts of vehicle emissions and associated pollution.*

Policy 2.2.1: Implement an idling policy for all City vehicles, and educate the public about the benefits of not idling vehicles.

Policy 2.2.2: Develop and implement idling measures that reduce or prohibit the idling of vehicles.

Policy 2.2.3: Encourage and develop incentives for agencies, organizations and companies with vehicular fleets, to install emission reduction devices on all vehicles, especially for engines manufactured after 1989.

Policy 2.2.4: Encourage truck facilities to employ ultra-high frequency identification (FID) (Ultra-HighFID) radio technology, or a technology of the like, to improve lot flow and aid incoming drivers of lot space.

Policy 2.2.5: Make education materials available at North Bend truck stop facilities and the truck drivers to inform and educate truck operators of emission reduction programs, rebates, and incentives.

Policy 2.2.6: Require for any permit meeting the city established threshold for compliance with the new code that commercial truck facilities provide heating and cooling as well as auxiliary power for convenience and refrigeration of cargo thereby permitting engine shut off and to comply with city idle code(s).

Policy 2.2.7: Work with County, State and Federal transportation agency planners and stakeholders to ensure that sufficient truck stop and parking facilities are provided and planned for along I-90 and Highway 18, between approximately the Snoqualmie summit and Preston, or as otherwise necessary to reduce the adverse impacts from trucks in North Bend.

Objective 2.3: *Comply with federal and state storm water controls and treatment, groundwater protection, and endangered species act requirements related to construction, operation, and maintenance of the North Bend transportation system.*

SINGLE OCCUPANT VEHICLE TRIP REDUCTION

Goal 3: Manage the City's transportation system and develop improvements that minimize trips by single occupant vehicles.

Objective 3.1: *To reduce traffic congestion, greenhouse gas emissions, and use of fossil fuels, seek ways to reduce overall vehicle miles traveled and single occupant vehicle trips by North Bend residents and employees.*

Policy 3.1.1: Establish and implement vehicle parking maximums and reduce vehicle parking minimums in the City's parking regulations to reduce the oversupply of vehicle parking not required by the actual parking demand.

Policy 3.1.2: Encourage use of bicycle and pedestrian modes of transportation for local trips by way of providing complete and interconnected streets and sidewalks, ensuring ample and convenient bicycle parking, and orienting buildings and land uses to sidewalks and pedestrians rather than to parking lots and vehicles.

Policy 3.1.3: Ensure that transportation concurrency requirements address all modes of transportation, including bicycle and pedestrian mobility.

Policy 3.1.4: Establish city work policies which support City employees to telecommute or to work flex schedules (such as longer days with a 4-day work week) to reduce commuting needs.

PEDESTRIAN AND BICYCLE TRANSPORTATION

Goal 4: Create a bicycle and pedestrian-friendly environment throughout North Bend that connects neighborhoods to the downtown, to cultural, historic, and recreational facilities, and to other transportation elements such as park-and-ride lots and transit routes and to include connectivity to the City of Snoqualmie.

Objective 4.1: ***Sidewalks.*** *Safe, attractive and barrier free pedestrian facilities should be provided as an essential element of the City's circulation and recreation system, in accordance with the following policies:*

Policy 4.1.1: Construct pedestrian facilities along all streets, and bicycle facilities along arterial and collector streets, in accordance with the City's street design standards.

Policy 4.1.2: Establish a pedestrian and bicycle network that is consistent with the Park & Open Space Plan and is connected to a greenway system which links commercial areas, employment centers, neighborhoods, and public facilities and include connectivity to the City of Snoqualmie.

Policy 4.1.5: Objects located on the sidewalk such as poles, benches, planters, bike racks, awnings, etc., should not impede pedestrian traffic.

Policy 4.1.6: Sidewalks should be located to accommodate existing natural features, such as significant trees within rights-of-way, when present.

Policy 4.1.7: Pedestrian safety should be a high priority in areas frequented by children, such as near schools, libraries, and park and recreation facilities. Pedestrian facilities should be provided in these areas at every opportunity.

Policy 4.1.8: Implement a system of pedestrian street crossings and signage which gives pedestrian safety a high priority.

Policy 4.1.9: Prioritize sidewalk construction funding, based on the following criteria:

(a) The improvement will enhance mobility for the disabled;

(b) The improvement will improve pedestrian safety (e.g., the route occurs along a roadway with high vehicular speeds or volumes);

(c) The improvement will result in links to key destinations;

(d) The improvement will complete a missing link in the sidewalk system;

(e) The improvement will be located in an area where there are no parallel pedestrian routes;

(f) The improvement will remove a significant pedestrian barrier;

(g) The improvement will promote intermodal trips;

(h) The improvement will accommodate either current or predicted high levels of pedestrian activity, such as to key destinations; and

(i) The improvement will match the needs in the district, i.e., commercial, retail or residential district.

Policy 4.1.10: The preferred pedestrian improvement will have curb, gutter and sidewalk, with planter strip. Appropriate levels of illumination should be provided. The minimum sidewalk width should be 5 feet, with wider sidewalks located in the Downtown and along heavily traveled arterial streets.

Policy 4.1.11: Develop pedestrian and bicycle facilities separated from the travel lanes as identified in the Parks and Open Space Element.

Policy 4.1.12: Require development to provide additional sidewalks along local streets to complete missing links, increase pedestrian safety, and provide linkages to key destinations. The preferred pedestrian improvements on local streets include curb, gutter, median strip and sidewalk, or, alternatively, pedestrian paths may be allowed.

Policy 4.1.13: Develop links between off-road and on-road pedestrian and bicycle facilities to provide an interconnecting system of trails.

Policy 4.1.14: Create development regulations which require new development to provide connections, or payments-in-lieu, to the City's bicycle/walkway trails system.

Policy 4.1.15: Payment-in-lieu of construction will be allowed under the following conditions:

(a) The City's latest six-year Capital Improvement Program (CIP) includes and specifically identifies City project for sidewalks at the location of the development project, and

(b) The City determines that it will be in the best interest of the City to construct sidewalks at the development project location as part of and concurrently with the City's identified capital project.

Objective 4.2: ***Bicycle Facilities.*** *Safe bicycle routes should be an integral part of the City's street and recreation plans, in accordance with the applicable policies in Objective O3.1 and the following additional policies:*

Policy 4.2.1: Sidewalks are not desirable for bicycle traffic due to obstacles and the presence of pedestrians. Separate bicycle facilities should be provided in congested areas, consistent with the Park & Open Space Plan.

Policy 4.2.2: Combination bicycle-pedestrian paths can be developed in non-congested areas.

Policy 4.2.3: The use of bicycles for transportation purposes in addition to recreation purposes should be encouraged, by providing bicycle lanes on appropriate collector and arterial streets, marked bicycle sharrows (travel lanes shared by bicycles and motor vehicles) where there is insufficient room for separate bicycle lanes and traffic speeds are low, and by maintaining existing roadway shoulders in a smooth and stable condition for safe bicycle travel.

Policy 4.2.4: Adopt and implement bicycle parking standards that ensure bicycle parking sufficient to accommodate 5 to 10% of projected use at all public and commercial facilities. Require the bicycle parking facilities be provided in close proximity to the building entrance.

PUBLIC TRANSPORTATION

Goal 5: The public transportation system shall provide alternatives to the use of automobiles that enable all persons to have reasonable access to locations of employment, health care, education, and community business activities.

Objective 5.1: *Public transportation shall be provided by King County Metro and other providers as an alternative to use of the automobile and as a means of reducing air pollution and greenhouse gas emissions, conserving energy, and relieving traffic congestion in accordance with the following policies:*

Policy 5.1.1: The adequacy of public transportation service shall be gauged according to three factors: a) geographic coverage, b) service frequency, and c) span of service. For concurrency purposes, an adequate level of transit service shall be considered to include regular fixed route service:

a) Focused geographically on the City Center area;

b) Providing hourly (60-minute) frequency on weekdays and Saturdays, and express bus service during weekday commute peak hours; and

c) Providing a span of service from 5:30 am to 8:30 pm on weekdays, and 8:30 am to 9:30 pm on Saturdays.

Policy 5.1.2: Public transportation should be convenient and flexible enough to meet community needs. Fixed route coverage should be expanded from the City Center area to be conveniently reached from all the City's residential neighborhoods, consistent with their growth and development.

Policy 5.1.3: Work with King County Metro Transit to increase the frequency of express bus service to Seattle and the east side.

Policy 5.1.4: The public transportation system should be dependable, maintain regular schedules and provide an adequate level of commuter service and during evening hours, weekends, and holidays.

Policy 5.1.5: Designated activity centers outside of North Bend should be served by frequent, regular transit service from the North Bend area.

Policy 5.1.6: Transit service should be designed to serve local and eastside commuting and activity patterns, and should be coordinated with the City and significant concentrations of employment. New development and redevelopment in activity centers shall be designed to provide and encourage pedestrian access to transit.

Policy 5.1.7: The city should work with larger employers to implement transportation strategies that encourage transit or alternative transportation usage by workers.

Policy 5.1.8: Promote the use of the Snoqualmie Valley Transportation's shuttles and dial-a-ride transit for local trip needs.

Policy 5.1.9: The public transit system should be based on transportation alternatives that are economically feasible for North Bend and King County Metro Transit.

(a) Specialized transportation, such as dial-a-ride service, should be available for disabled and mobility-impaired people, consistent with ADA requirements. Transportation demand management actions should be encouraged and provided as a method for helping to meet access and parking requirements for new and existing development.

Policy 5.1.10: Coordinate and encourage joint public/private efforts to participate in transportation demand management and traffic reduction strategies.

Policy 5.1.11: The City should support the placement of pedestrian access and signage to better integrate the train depot into the downtown.

Policy 5.1.12: More efficient use of existing public rights-of-way is encouraged to increase parking opportunities within the downtown core.

Policy 5.1.13: North Bend should endorse grant applications for the Northwest Railway Museum when the grant directly benefits the upper Snoqualmie Valley economic and transportation goals and policies.

Policy 5.1.14: Promote the use of the North Bend Park and Ride for carpooling and available King County Metro Transit services to reduce single-occupant vehicle commuting.

STREETSCAPE

Goal 6: Incorporate streetscape design in the development and redevelopment of North Bend streets to enhance our scenic beauty and help preserve our historic downtown and neighborhoods.

Objective 6.1: *Follow adopted design standards to create an attractive street system consistent with the character of the City of North Bend.*

Policy 6.1.1: Implement roadway design standards that enhance the small town atmosphere of North Bend.

Policy 6.1.2: Crosswalks should be six feet wide and designed to meet ADA standards.

Policy 6.1.3: Street lights shall be utilized for the safety and welfare of North Bend residents and the traveling public while protecting the rural character, quality of life, and economic well-being of the city with the following guidelines:

(a) Lighting fixtures shall be standardized and enhance the character and reflect on the history of the community; and

(b) Unnecessary light and glare which cause light pollution that may diminish the natural environment, including the beauty, high quality, and visibility of the night sky, shall be avoided by requiring shielded, full cut-off, and directional lighting fixtures.

Policy 6.1.4: Street trees should be installed along all streets in accordance with the City's street tree standards.

Policy 6.1.5: Develop a Downtown circulation pattern that provides adequate capacity for the traffic demand while implementing a plaza design, within the Downtown core, that provides a multi-purpose right-of-way during times of community gatherings.

Policy 6.1.6: Minimize the visual clutter of traffic control electrical boxes, vaults, and other such transportation-related equipment through appropriate placement, screening, and landscaping.

CAPITAL FACILITIES, TRANSPORTATION

Goal 7: Establish appropriate levels of service for transportation facilities to adequately serve existing and future development.

Objective 7.1: *Identify and define the transportation facilities in the City of North Bend.*

Policy 7.1.1: Maintain an inventory of existing transportation facilities owned or operated by the City and Washington State within North Bend. Include in the inventory the locations and capacities of such facilities and systems.

Policy 7.1.2: Establish and maintain an annual traffic count program.

Policy 7.1.3: Maintain a traffic collision record system to evaluate and determine appropriate traffic safety measures.

Policy 7.1.4: Encourage design standards that minimize the number of curb cuts and points where vehicles cross over the sidewalk.

Objective 7.2: *Establish level of service standards for City owned transportation facilities in North Bend and adopt the State and PSRC level of service standards for state owned and regional facilities in order to achieve and maintain the desired quality of life and vision for the City of North Bend.*

Policy 7.2.1: Establish level of service standards which (1) measure the quality of life based on the City's vision of its future and values, (2) can be achieved and maintained for existing development and growth anticipated in the land use plan, and (3) are achievable with the TIP and the Comprehensive Plan. The following are the standards for City streets and transit services:

Facility	Standard
City Streets	(a) All arterial street intersections shall operate at LOS D or better during peak periods, except the Bendigo/North Bend Way intersection, which shall be exempted due to constrained right-of-way and urban character.
Transit	(a) Service to activity centers or urban centers via transit hub, including Park and Ride lots. (b) Span of service 6 a.m. to 9 p.m. (c) Weekday peak service frequency: 60 minutes or better, also express service. (d) Weekday off-peak service frequency: 60 minutes or better.

Policy 7.2.2: Use the level of service standards to (1) determine the need for transportation facilities, and (2) test the adequacy of such facilities to serve proposed development. In addition, use the level of service standards for city-owned transportation facilities to develop the City's annual budget and 6-year Transportation Improvements Program (TIP).

Policy 7.2.3: Re-assess the TIP annually to ensure that transportation facilities needs, financing, and levels of service are consistent with the land use plan. The annual update should be coordinated with the annual budget process, and the Capital Improvement element amendment of the Comprehensive Plan.

Policy 7.2.4: Re-evaluate proposed land-use plan designations as necessary should funding for necessary transportation infrastructure not be available.

Objective 7.3: *Provide a variety of responses to the demands of growth on transportation facilities.*

Policy 7.3.1: Ensure City transportation facilities and services are provided concurrent with the impact of new development or redevelopment.

Policy 7.3.2: Make the most efficient use of existing transportation facilities, including techniques such as:

(a) Transportation demand management

(b) Encourage development that uses existing facilities

Policy 7.3.3: Provide additional transportation facility capacity when existing facilities are used to their maximum level of efficiency consistent with adopted standards for levels of service.

Policy 7.3.4: Encourage development where adequate transportation facilities and services exist or can be provided in an efficient manner.

Objective 7.4: *Coordinate transportation planning and programming with state, county, and local agencies.*

Policy 7.4.1: Coordinate with non-City providers of transportation facilities and services on a joint program for maintaining adopted levels of service standards, funding, and construction of capital improvements. Work in partnership with non-City transportation facility providers to prepare functional plans consistent with the City of North Bend Comprehensive Plan.

Policy 7.4.2: Establish interagency planning mechanisms to assure coordinated and mutually supportive transportation facility plans from non-City providers (WSDOT, King County Roads and Metro Transit, adjoining cities, etc.) of transportation facilities.

(a) Establish priority areas for transportation improvements consistent with the Comprehensive Plan.

(b) Periodically assess development trends and transportation facility needs to identify and remedy deficiencies or reassess the land use plan.

Policy 7.4.3: Regularly coordinate with WSDOT, King County Roads and Metro Transit, and the City of Snoqualmie to ensure that levels of service for transportation facilities are compatible.

Policy 7.4.4: Encourage additional improvements to enhance high-occupancy vehicle travel on I-90.

Policy 7.4.5: Coordinate Federal, State, County, City agencies, the Ports, and freight mobility industry leaders to develop a Regional Plan for freight mobility and staging, within the Puget Sound regional, that allows for efficient mobility while reducing or eliminating impacts on North Bend's streets and air and water quality.

Objective 7.5: *Annually develop a six-year transportation improvements program with which to facilitate implementation of the Comprehensive Plan.*

Policy 7.5.1: Prepare and utilize the six-year TIP to identify transportation projects necessary to respond safety issues, the planned growth of the community, and maintain desired levels of service.

Policy 7.5.2: Prepare and utilize the six-year TIP to integrate North Bend transportation capital projects and resources with other agencies in order to maximize financing opportunities such as grants, bonds, city funds, donations, impact fees and other available funding.

Policy 7.5.3: Maintain the TIP as follows:

(a) Provide for annual review of the Capital Facilities Plan contained in this Capital Facilities Element by the City Council and incorporate a citizen participation process;

(b) Ensure that the Capital Facilities Plan is consistent with the overall Comprehensive Plan;

(c) Defines the projects' need and links to levels of service and facility plans;

(d) Considers operations and maintenance impacts where appropriate; and

(e) Establishes project priorities in the order of safety first and then LOS.

Objective 7.6: *Establish mechanisms to ensure that the required transportation facilities are financially feasible.*

Policy 7.6.1: Base the financing plan for transportation facilities on realistic estimates of current local revenues and external revenues that are reasonably anticipated to be received by the City on an ongoing basis.

Policy 7.6.2: Finance the six-year TIP within the City's financial capacity to achieve a balance between available revenue and needed transportation facilities. If the projected funding is inadequate to finance needed transportation facilities based on adopted level of service standards and forecasted growth, the City could do one or more of the following:

(a) Lower the level of service standard;

(b) Change the Land Use Plan;

(c) Increase the amount of revenue from existing sources; and/ or

(d) Adopt new sources of revenue.

Policy 7.6.3: Design roads to be financially feasible to maintain, by means of reduced impervious surfaces and implementation of low impact strategies that reduce maintenance costs, in addition to providing a well-connected street system, reducing the miles of roadway necessary to provide adequate circulation and access throughout the City.

Objective 7.7: *Establish mechanisms to ensure that the required transportation facilities are fully funded.*

Policy 7.7.1: Match revenue sources to transportation improvements on the basis of sound fiscal policies.

Policy 7.7.2: Revise the TIP in the event that revenue sources for transportation improvements, which require voter approval in a local referendum, are not approved.

Policy 7.7.3: Ensure that the ongoing operating and maintenance costs of a transportation facility are financially feasible prior to constructing the facility.

Objective 7.8: *Ensure existing and future development pay for the costs of needed transportation improvements.*

Policy 7.8.1: Ensure that existing development pays for transportation improvements that reduce or eliminate existing deficiencies, and pays for some or all of the cost to replace obsolete or worn out facilities. Existing development may also pay a portion of the cost of transportation improvements needed by future development. Existing development's payments may take the form of user fees, charges for services, special assessments, and taxes.

Policy 7.8.2: Ensure that future development pays a proportionate share of the cost of new facilities that it requires. Future development may also pay a portion of the cost to replace obsolete or worn-out facilities. Future development's payments shall take the form of one or more of the following: voluntary contributions for the benefit of any transportation facility, impact fees, mitigation payments, capacity fees, dedications of land, provision of transportation facilities, and future payments of user fees, charges for services, special assessments, and taxes.

Policy 7.8.3: In the annual budget, the city shall maintain its bridges, arterials, and collector streets system and implement safety improvements as a high priority. Development of new bridges, arterials, and collector streets should, subject to the availability of outside grant opportunities, be a secondary budget priority.

Objective 7.9: *Seek to mitigate disproportionate financial burdens to the City due to the siting of essential transportation facilities and freight mobility facilities.*

Policy 7.9.1: Through joint planning or interlocal agreements, the City shall seek to mitigate disproportionate financial burdens due to the siting of essential transportation facilities.

Policy 7.9.2: The City shall seek amenities or incentives for neighborhoods in which the facilities are located, and require compensation for adverse impacts.

Chapter 3: Transportation Inventory

This chapter describes the transportation and land use efforts with which this plan has been coordinated, provides an inventory of the components of the current transportation system, and presents the existing adopted Transportation Improvement Plan.

REPORTS, PLANS AND RECORDS

Adopted City plans and prior reports were integral to the assessments presented in this chapter. Information was obtained from the following sources:

- **City of North Bend Comprehensive Plan** . This document contains plans, policies and regulations for land use, sensitive areas, housing, transportation, utilities and capital facilities for the City of North Bend.
- **Highways of Statewide Significance**. A list of all Washington State highways that have been identified as a Highway of Statewide Significance compiled by the Washington State Transportation Commission, by Resolution #584.
- **City of North Bend Heritage Corridor Gateway Master Plan Narrative**, November, 1999. This documents the concept plan for potential improvements to Bendigo Boulevard from Ribary Way to NE 4th Street. The plan discusses coordinated lighting, landscaping, public art and signage, including a bikeway and pedestrian system.
- **City of North Bend Design Standards.** This document compiles design standards and guidelines for context, site, building, landscape, sign, and circulation.
- **City of North Bend Park Plan**. This plan provides for trails, paths, and bike routes through the city.
- **North Bend Gravel Operation Final EIS, Appendix M** – Transportation Technical Report, URS, December 2001
- **WSDOT Truck Parking Study – Final Report**, prepared for WSDOT by Parametrix, December 2005
- **Middle Fork Business Park - SEPA DNS and MDNS**, King County DDES: October 20, 2000; November 4, 2002; and July 9, 2008
- **Middle Fork Road Re-Paving Project**, contacted by Michael Traffalis, FHWA; June, 2011

LAND USE REVIEW

Land use changes are integral to projecting traffic volume increase over time. For the purpose of the Transportation Plan Update, existing and projected land uses within the Urban Growth Area (City Limits plus the Annexation Area) were collated. In addition land use data was obtained from King County for parcels located outside the UGA, but may create a transportation need or impact, i.e. Cadman and Twin Falls Middle School. The projected land use change by subarea from 2011 through 2030 is shown graphically for residential units in Figure 3, and for employment growth in Figure 4. The identified changes were provided by City of North Bend staff based on known subdivision permitting activity and anticipated changes consistent with available land capacity and the adopted Comprehensive Plan. For detailed information related to projected Residential Capacity and Employment Capacity, refer to the North Bend Comprehensive Plan Land Use Element section H.

STATE OWNED TRANSPORTATION FACILITIES

As required under the WA Growth Management Act (GMA), comprehensive plan transportation elements are required to include a sub-element addressing state-owned transportation facilities, and transportation facilities of statewide significance. This section of the City's Transportation Element complies with the GMA requirements by providing:

- An inventory of state-owned facilities within the North Bend Planning Area;
- Estimates of traffic impacts to state-owned facilities resulting from land use decisions so performance can be monitored and improvements can be planned;
- State adopted level of service (LOS) standards for measuring state facility performance;
- Identified current and future state facility needs that are consistent with WSDOT's statewide transportation plan.

Inventory of State Owned Facilities

Interstate 90. *I-90* is designated as a Highway of Statewide Significance (HSS) and a Strategic Freight Corridor (per RCW 47.06A.010). It is functionally classified as a Freeway by WSDOT, and it is rated on the Washington State Freight and Goods Transportation System (FGTS) as a T-1 facility carrying more than 10,000,000 tons per year(2011 update). The Strategic Freight Corridor designation emphasizes its economic importance because it serves both international and interstate trade, and enhances the state's competitive position through regional and global gateways. In addition to freight, I-90 serves commuter, neighborhood, business and recreational travelers. Within the planning area, interchanges with I-90 are located at State Route 202 - Bendigo Boulevard, 436th Avenue SE, and 468th Avenue SE. I-90 is a critical transportation corridor, linking the Puget Sound region to eastern Washington and beyond. I-90 is a fully access-controlled, multi-lane divided highway through the North Bend planning area.

State Route 202 – Bendigo Boulevard. SR 202 (Bendigo Boulevard) is a primarily east/west highway connecting from I-90 through Downtown North Bend westward through the cities of Snoqualmie, Fall City, Redmond and to Woodinville. It intersects with State Routes 203, 908 and 520, and terminates at SR 522 in Woodinville.

FIGURE 3: DWELLING UNIT GROWTH BY SUBAREA, 2011-2030

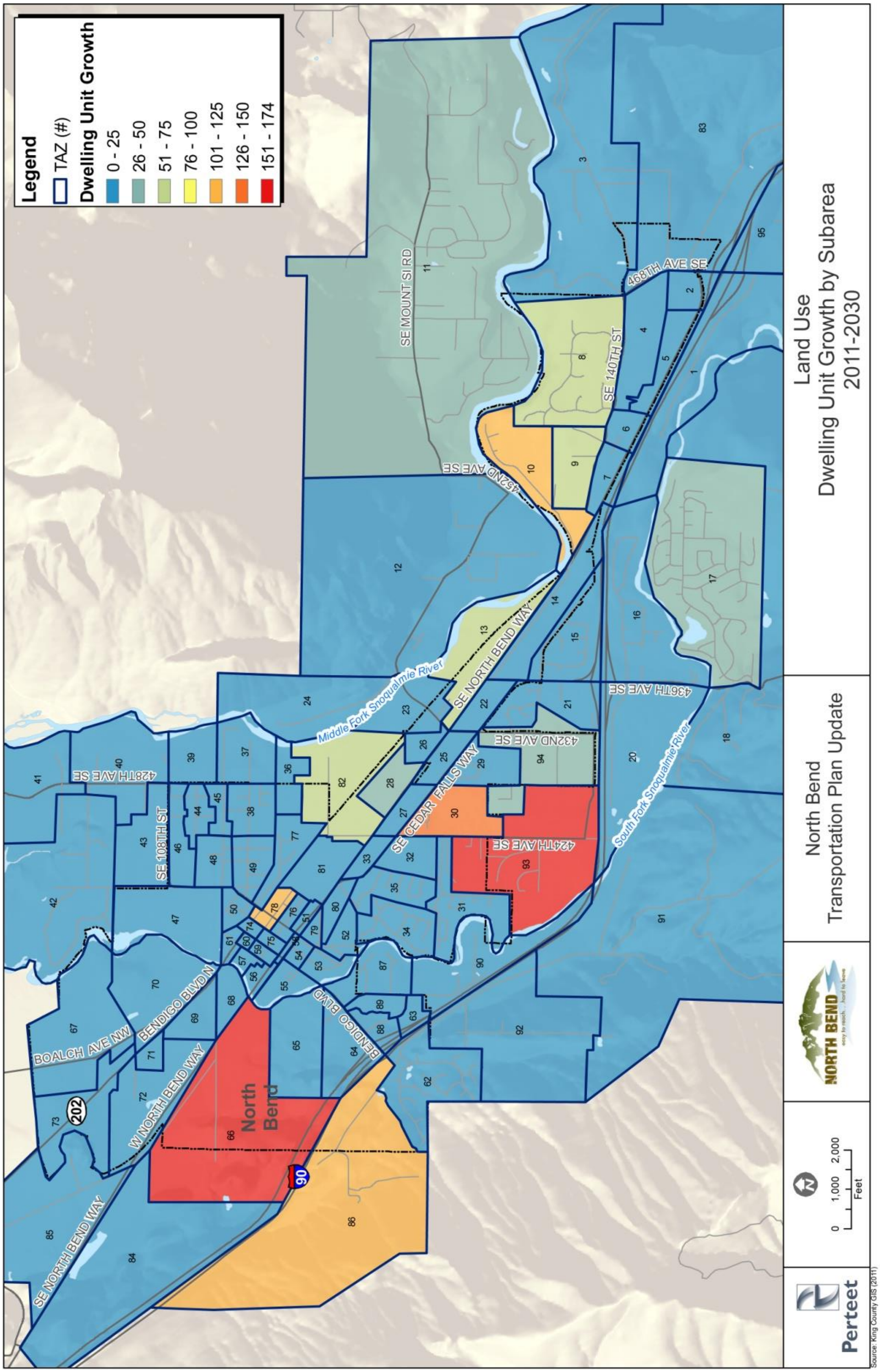

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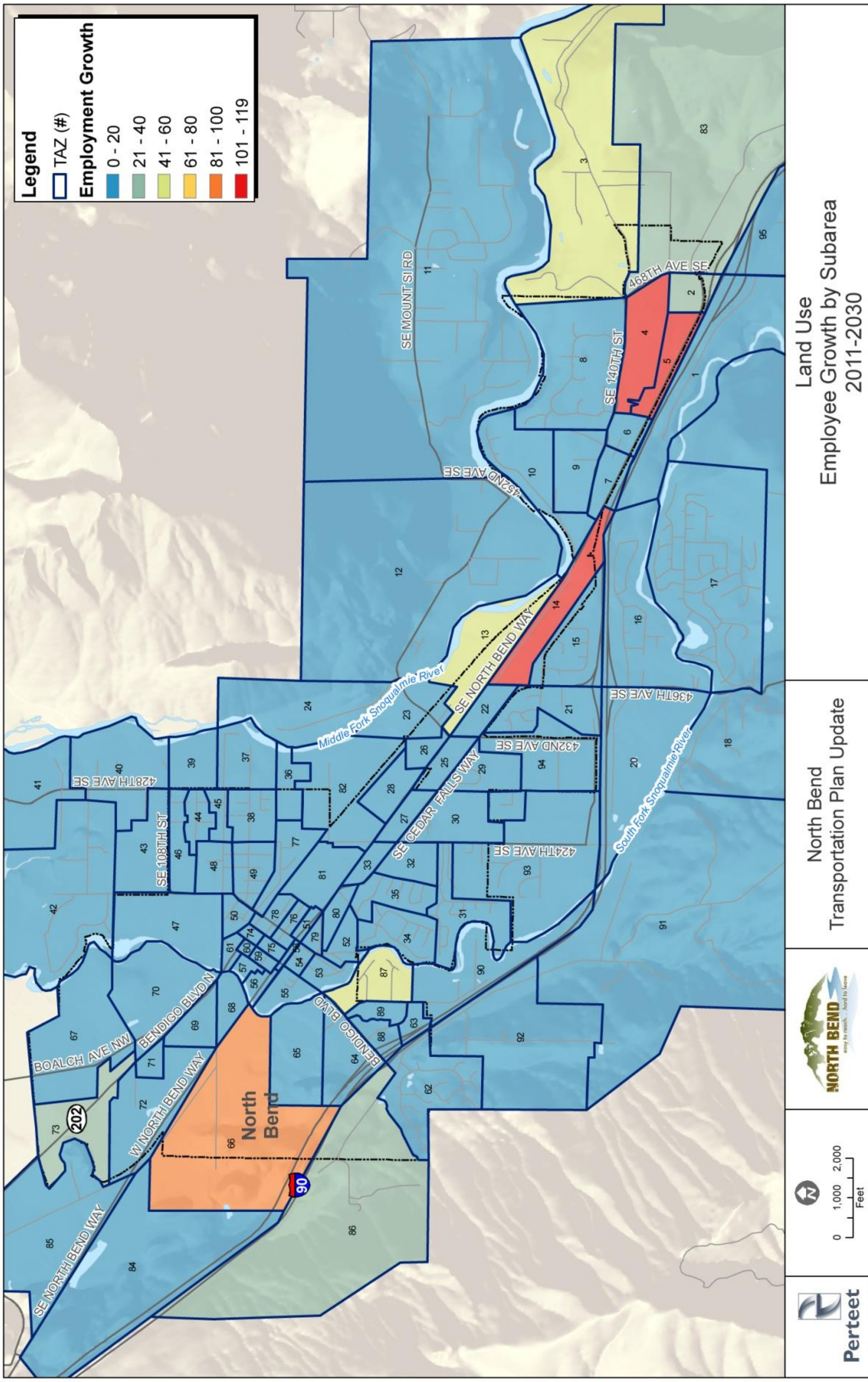
FIGURE 4: EMPLOYEE GROWTH BY SUBAREA, 2011-2030



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Within the City of North Bend, the typical two-lane cross section changes as follows: there is a three lane section between the I-90 ramp terminals (two northbound, one southbound); and a four lane section between the I-90 westbound ramps and South Fork Avenue SW. There are bike lanes between I-90 and the bridge over the South Fork of the Snoqualmie River, and intermittent sidewalks along the route through the City. The remaining portion of the state route through the City is a two-lane roadway. The completion of bike and pedestrian facilities is a priority for improvement, as is revising the intersection configuration of Bendigo Boulevard at NE 4th Street to allow southbound to eastbound travel.

Planned Improvements to State Owned Facilities

The WSDOT is preparing a Corridor Study for I-90 from Eastgate in Bellevue to 465th Avenue SE in North Bend (as of February 2012). The Corridor Study was funded by the State Legislature at $2 million to identify safety and mobility improvement needs over the next two decades. It was mandated by the Federal Highway Administration's approval of the Sunset Interchange construction on I-90 in Issaquah. A Corridor Study Plan is scheduled for completion in Spring 2012. The City of North Bend was represented on the Corridor Working Group by Ron Garrow, Public Works Director. No other improvements are planned by WS DOT for either I-90 or SR 202 within the North Bend planning area in the *WSDOT State Highway System Plan.*

Recent Project Improvements Along State Facilities

- In 2005, the City installed pedestrian facilities along SR 202 between Ribary Way and the South Fork Bridge immediately north of South Fork Avenue.
- In 2007 WS DOT completed construction of a 2-lane roundabout at the eastbound I-90 ramp to SR 202-Bendigo Boulevard to improve safety and traffic flow. This improvement provides an important gateway to the City.
- Also in 2007, WS DOT repaved a 4.5 mile section of SR 202 at a cost of $2.4 million, with center line rumble strips and guard rails to improve safety, from SR 203 in Fall City to W. North Bend Way, providing an improved linkage to Snoqualmie and Fall City.
- In 2010, the City installed a signal at the intersection of SR 202 and Park Street, a high accident location. Since its installation, accident rates have fallen dramatically.
- In 2011, the North Bend Park and Ride lot was constructed by the City in Downtown North Bend on W. North Bend Way adjacent to the SR 202 corridor with a $230,000 federal grant from the American Recovery and Reinvestment Act (ARRA).

Traffic Impacts to State Owned Facilities

Traffic impacts on state owned facilities from the City's anticipated development through the 2030 forecast year are shown in the next chapter, Forecasting Future Travel Demand. The projected development is consistent with the Land Use Element of the North Bend Comprehensive Plan.

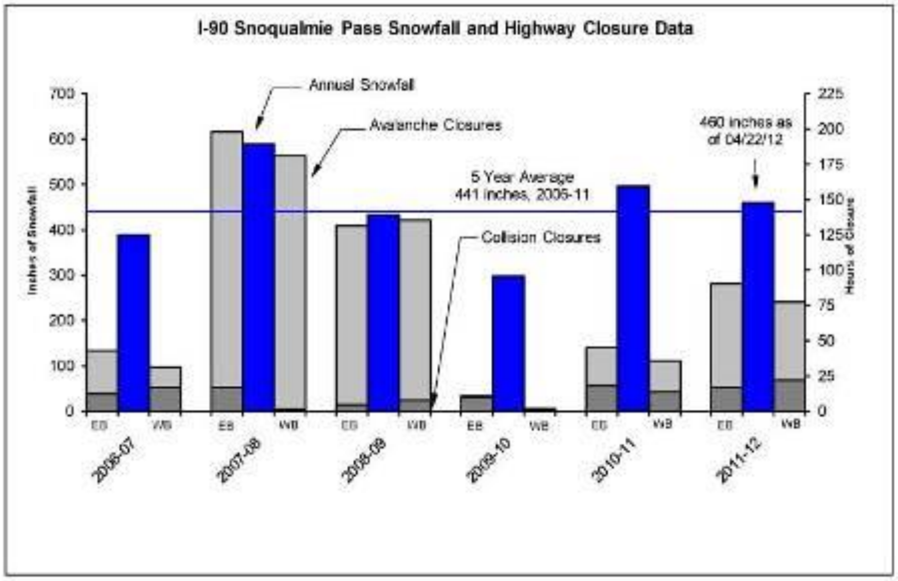
LOS and Concurrency for Highways of Statewide Significance

I-90 is designated a Highway of Statewide Significance (HSS) by WSDOT who has established a traffic level of service (LOS) standard of "D" for the highway through the North Bend Planning Area. Local transportation concurrency requirements do not apply to HSS facilities. The Puget Sound Regional Council has adopted a LOS standard of "D" for Tier II regionally significant state highways, which include SR 202 through North Bend. Regionally significant state highways are state transportation facilities that are not designated as being of statewide significance. PSRC took this action to comply with 1998 amendments (HB 1487, the "Level of Service Bill") to the Growth Management Act (GMA). Adoption of LOS standards for regionally significant (also called non-HSS) state highways followed a yearlong process involving WSDOT and the region's cities and counties. For further information, see the PSRC website, psrc.org.

INTERSTATE TRUCKING

The City of North Bend acknowledges that the I-90 corridor is rated as a significant transportation corridor carrying more than 10,000,000 tons of freight per year and is recognized as a Strategic Freight Mobility Corridor by Washington State Department of Transportation. The City also recognizes that the existing commercial truck facility located at the I-90 Exit 34 is the largest commercial truck facility currently located in King County. This commercial truck facility serves the Freight Mobility needs of the I-90 corridor connecting Washington agriculture businesses and other industries with urban markets in northwest Washington and Puget Sound, along with global markets via the ports of Seattle, Tacoma, and Everett. On a typical weekday, approximately 6,500 trucks travel over I-90 at Snoqualmie Pass providing a strategic freight corridor for international and domestic trade. This Regional Freight Mobility Corridor impacts the transportation corridors, economic vitality, safety, health and environmental elements of the City of North Bend and surrounding communities. The City of North Bend is committed to an ongoing effort to conduct, coordinate, and support local and regional efforts to mitigate these impacts from the Regional Freight Mobility activity within the boundaries of the City.

The City of North Bend includes a truck stop facility within its boundary, at Exit 34 on I-90. As of 2012, this truck stop has an average of 175 trucks parked overnight, with about 900 trucks using exit 34 each day. Additionally, approximately 300 - 400 trucks park between exit 32 and 34 when Snoqualmie Pass closes due to weather events or emergencies. This is unpredictable, as shown in the below WSDOT chart of pass closures from 2006 to present. The truck stop serves interstate truck trips including those destined to the greater Puget Sound area such as the Ports of Seattle and Tacoma, as well as local destinations such as the Cadman mine, Bessemer mine, Terex and other businesses accessed from this exit.



Source: http://www.wsdot.wa.gov/winter/snoqualmie/

Local citizens have expressed concerns regarding the heavy truck traffic in the Exit 34 area as it relates to the traffic and pedestrian safety of local residents and those accessing the Twin Falls Middle School and the future elementary school site, the increasing traffic accessing State and National Forest lands in the Middle Fork basin, and health concerns regarding emissions from idling at the truck stop facility on local residents.

Future intersection and roadway improvements in this area will need to be planned specifically to address the sizes and needs of heavy truck traffic, and the City will need to coordinate with other agencies and jurisdictions, including the Washington State Department of Transportation, the Port of Seattle, King County, and others, to work toward cooperative solutions to address these unique challenges.

CITY STREET INVENTORY

Transportation roadway systems consist of a hierarchy of streets that provide the dual functions of access to land and development, and mobility for travelers. Streets are classified based upon the relative degree to which they provide these functions. Land use policies and street standards typically vary according to the street function. For example, most jurisdictions designate minimum right-of-way (ROW) requirements, stopping and entering sight distances, roadway width, design speed, design traffic volumes, access control, and sidewalk requirements in accordance with an adopted classification system. These requirements are usually codified in the jurisdiction's municipal code and/or adopted as street standards.

Following is an inventory of the elements of the current roadway system within the City of North Bend.

Roadway Functional Classification System

Based on state law, cities and counties are required to adopt a street classification system that is consistent with State and Federal guidelines. In the State of Washington, these requirements are codified in RCW 35.78.010 and RCW 47.26.090. Each local jurisdiction is responsible for defining its transportation system into the following three functional classifications: principal arterial, minor arterial, and collector. All other roadways are assumed to be local access streets.

The North Bend roadway functional classifications, together with the list of streets designated for each functional class, are described below. Figure 5 shows a graphic representation of the City's functional class system as of the 2003 Transportation Element, and the changes to some of those functional designations in this 2012 update process.

Freeway/Interstate The City of North Bend has one freeway, I-90, which is situated at the southern end of the City Limits. I-90 represents the interstate corridor for traffic to the Seattle-King County metro area and for traffic going east.

Principal or major arterial is a roadway that connects major community centers and facilities, and is often constructed with limited direct access to abutting land uses. The primary function of major arterial streets is to provide a high degree of vehicular mobility; however, they may play a minor role in providing land access. Principal arterials serve high-volume corridors, carrying the greatest portion of through or long-distance traffic within a city, serving inter-community trips that connect major activity centers. There following are the only roadways currently designated as major arterials in the City of North Bend and its UGA, namely:

- SR-202 (Bendigo Boulevard) along its entire length within the North Bend City Limits
- North Bend Way, from the west city limit to 468th Avenue SE
- 436th Ave SE from North Bend Way to I-90
- 468th Ave SE from North Bend Way to I-90

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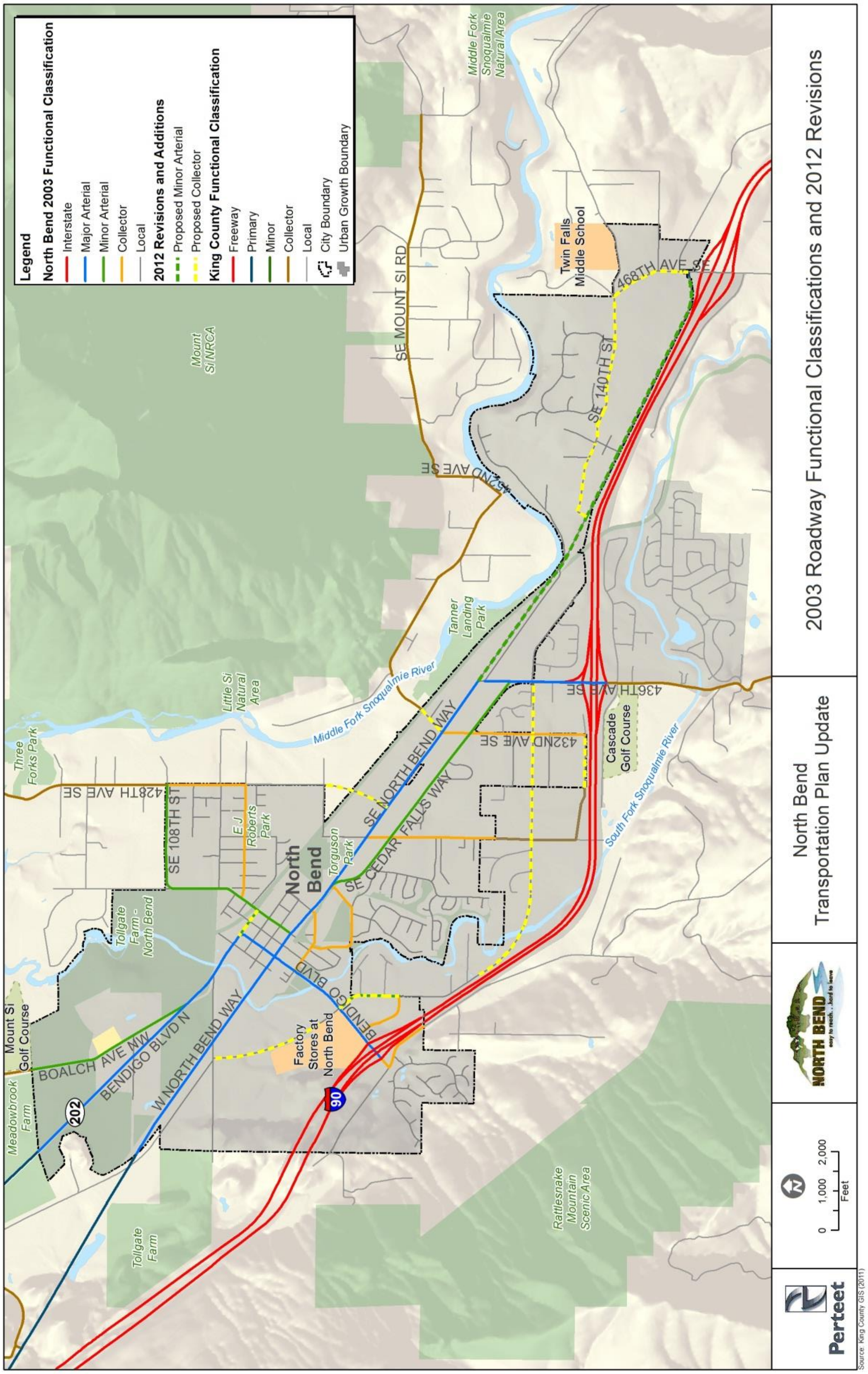
FIGURE 5: 2003 ROADWAY FUNCTIONAL CLASSIFICATIONS AND 2012 REVISIONS



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Minor arterial is a roadway connecting centers and facilities within the community and serving some through traffic, while providing a greater level of access to abutting properties. They can typically be found in residential, commercial and industrial areas. Minor arterials connect with other arterial and collector roads extending into the urban area, and serve less concentrated traffic-generating areas, such as neighborhood shopping centers and schools. Minor arterial streets serve as boundaries to neighborhoods and collect traffic from collector streets. They generally have greater right-of-way and pavement width, and wider traffic lanes than residential streets. They often have continuous left-turn lanes and are normally provided with sidewalks and planting strips. Provision for on-street parking varies by location. Although the predominant function of minor arterial streets is the movement of through traffic, they also provide for considerable local traffic with origins or destinations at points along the corridor.

The following is a list of roadways currently designated as minor arterials in the City of North Bend:

- SE Cedar Falls Way—between E North Bend Way and 436th Avenue SE,
- Maloney Grove Avenue SE—between North Bend Way SE and the south City Limits,
- Ballarat Avenue—between E North Bend Way and NE 12th Street,
- NE 4th Street—between Bendigo Boulevard and Ballarat Avenue,
- Mt. Si road – North Bend Way to north City Limits,
- South Fork Road – SR 202 to Mt. Si Blvd.,
- 424th Ave SE – North Bend Way to Cedar Falls Way,
- NE 12th Street—between Ballarat Avenue and Pickett Avenue, and
- Boalch Avenue—between SR-202 and the north City Limits.

Collector is a roadway designed to fulfill both functions of mobility and land access. Collectors typically serve intra-community trips connecting residential neighborhoods with each other, or activity centers, while also providing a high degree of property access within a localized area. These roadways "collect" vehicular trips from local access streets and distribute them to higher classification streets. Additionally, collectors provide direct services to residential areas, local parks, churches and areas with similar uses of the land. Collectors may be separated into principal and minor designations according to the degree of travel between areas and the expected traffic volumes. Typically, right-of-way and paving widths are narrower for collectors than arterials. They may only be two lanes wide and are quite often controlled with stop signs.

Some collectors may be further designated as neighborhood collectors. These roadways provide a high degree of access to individual properties. They do not apply to commercial and industrial areas, or to most multi-family residential areas. Left turn lanes are only infrequently used on neighborhood collectors, and then only at intersections with higher traffic volume streets.

The following is a list of roadways currently designated as collectors in the City of North Bend:

- SW Mount Si Boulevard—between Bendigo Boulevard and South Fork Avenue,
- Main Avenue—between Park Street and 4th Street,
- 3rd Street—between Sydney Avenue and Ballarat Avenue,

- Park Street—between Bendigo Boulevard and E North Bend Way,
- Orchard Drive/Healy Ave—between Park Street and E North Bend Way,
- 6th Street—between Ballarat Avenue and Pickett Avenue, and
- Pickett Avenue—between 6th Street and 12th Street.
- 424th Avenue SE, 3rd Street to south city limit
- 432nd Avenue SE, SE 140th Street to E North Bend Way
- 415th Ave SE – Mt. Si Blvd to south City Limits
- West Ribary Way – Bendigo Blvd to west City Limits

Local Access Street is a roadway with a primary function providing access to residences. Typically, local streets are only a few blocks long and are relatively narrow. All roadways in the City of North Bend that have not been designated as an arterial or a collector roadway are considered to be local access streets. Shown in black in Figure 5, local access streets make up the large portion of the miles of roadways in the city.

TRAFFIC CONTROL

Listed below are key study intersections controlled by traffic signals or those controlled by two-way or all-way stop signs. Currently, there are four intersections within the North Bend City Limits that are signalized. They include:

- Bendigo Boulevard and Mt. Si Boulevard,
- Bendigo Boulevard and South Fork Avenue,
- Bendigo Boulevard and North Bend Way, and
- Bendigo Boulevard and Park Street.

Two intersections are controlled by roundabouts, which require entering vehicles to yield to vehicles already within the approaching roadway. These are located at:

- Bendigo Boulevard and I-90 Eastbound off-ramp/East Ribary Way
- North Bend Way and SE Cedar Falls Way

Intersections that are controlled by two-way stop control on the minor approach leg include:

- Ballarat Avenue and North Bend Way
- Main Avenue and North Bend Way
- Main Avenue and Park Street
- Park Street and North Bend Way

- 4th Street and Bendigo Boulevard
- 6th Street and Ballarat Avenue
- Westbound I-90 off-ramp and Bendigo Boulevard
- 432nd Avenue SE and SE Cedar Falls Way
- 432nd Avenue SE and North Bend Way
- 436th Avenue SE and SE 142nd Street
- 436th Avenue SE and I-90 Eastbound off-ramp
- 436th Avenue SE and I-90 Westbound off-ramp
- 436th Avenue SE and SE Cedar Falls Way
- 436th Avenue SE and North Bend Way
- SE 140th Street and SE North Bend Way
- SE 140th Street and SE Middle Fork Road
- 468th Avenue SE and SE 150th Street
- 468th Avenue SE and Eastbound I-90 off-ramp
- 468th Avenue SE and Westbound I-90 off-ramp
- 468th Avenue SE and SE North Bend Way
- 468th Avenue SE and SE 146th Street
- 468th Avenue SE and SE 144th Street
- 468th Avenue SE and SE Middle Fork Road

Roadway Design Standards

The City of North Bend Municipal Code has adopted Standards for development of City streets. The *Goals and Objectives* of the Transportation Element relate street design to the desires of the local community, and advise that design be at a scale commensurate with the function that the street serves. Standards are therefore important to provide designers with essential elements of street design as articulated by the community. Essential functions of streets in North Bend should be multimodal and include vehicle mobility, pedestrian access, and bicycle access and lanes.

TRANSIT SERVICE

Existing Bus Service

Currently the city of North Bend is served with two King County Metro bus routes and Access paratransit service for the disabled. Hourly fixed-route bus service is provided Monday through Saturday by local Route 209 between the Premium Outlet mall and Issaquah TC serving the rural communities en-route. Route 215 provides commuter peak-direction service from downtown North Bend to and from downtown Seattle via Snoqualmie Ridge and Eastgate with five round trips. No Sunday service is provided in North Bend.

TABLE 1: NORTH BEND BUS ROUTE SUMMARY

Route	Destinations Served	Weekday	Saturday	Average Weekday Boardings
209 - to Issaquah Transit Center	North Bend Premium Outlets, Mt Si Senior Center, Bendigo Blvd, city of Snoqualmie, Snoqualmie Falls, Fall City, Preston, High Point freeway stop and Gilman Village	Hourly 5:30am-8:30pm	Hourly 8:30am-9:30pm	102
215 - to Downtown Seattle	Mt Si Senior Center, city of Snoqualmie, Snoqualmie Ridge, Issaquah TC, Eastgate Freeway Station, Rainier Ave Freeway Station	Peak-Periods To Seattle - 5 trips 5am-7:15am To North Bend - 5 trips 3:45pm-6:10pm	No service	21

Boardings and Alightings

Within the city of North Bend, there are four locations with significant passenger boarding activity. There are very few boardings on Route 215 at the North Bend Park and Ride. The following charts summarize the average weekday boarding activity during the Spring 2011 Service Change time period.

TABLE 2: BOARDING ACTIVITY SUMMARY BY ROUTE

Route 209 Bus Stop Locations	Average Daily Boardings	Average Daily Alightings
North Bend Premium Outlet (terminal)	47	43
Stow Ave & Healy Ave	10	6
Main Ave & Park St	25	8
SR 202 & Sidney Ave (WB)	12	2
SR 202 & Sidney Ave (EB)	0	11

Route 215 Bus Stop Locations	Average Daily Boardings	Average Daily Alightings
Stow Ave & Healy Ave	7	19
Main Ave & Park St	8	6
North Bend Wy & Sydney Ave (Park/Ride WB)	4	1
North Bend Wy & Sydney Ave (Park/Ride EB)	0	2

North Bend Park and Ride

The North Bend Park and Ride project, located at North Bend Way and Sydney Ave, was completed at the end of December 2010. There are approximately 80 parking stalls at this location. This was a city of North Bend project in cooperation with King County Metro.

Planned Service Changes

There are no plans to adjust North Bend service at this time. King County Metro Transit's Strategic Plan and Service Guidelines call for alternatives to fixed-route transit service in urbanized areas surrounded by rural land (strategy 6.2.3). If cuts are required, Route 209 may be reduced to a bus every two hours with no weekday service provided after 7:00 pm.

Refer to the King County Metro website for up to date information on routes and schedules.

PARATRANSIT SERVICE

The Americans with Disabilities Act (ADA) of 1990 requires that some form of paratransit service be provided for individuals with disabilities who are unable to use fixed-route transportation systems. This type of service also caters to the elderly citizens and to those who have no access to a car or the transit system. Provision of such service varies from place to place, and is usually provided by a non-government entity. (Paratransit is a term that applies to any non-conventional form of mass transportation and typically includes carpools and vanpools as well as the type of service referred to in this paragraph). The Mt. Si Senior Center provides a very limited paratransit service to the Snoqualmie Valley Area. This is a dial-up service catered mainly to senior citizens, as well as disabled adults.

NON-MOTORIZED MODES

Bikeways and Trail System

The City of North Bend is ideally situated to benefit from regional recreational attractions that surround it on all sides, but especially Rattlesnake Lake and the Iron Horse Trail to the southeast, the Middle Fork-Snoqualmie Recreation Area to the east, the Mount Si Recreation Area to the north, and the Meadowbrook Farm/Tollgate Farm Park and Open Space area to the northwest. The city's connections to these attractions for non-motorized users such as cyclists and hikers include a combination of off-street trails and pathways and striped shoulders on existing roadways. The City's adopted Comprehensive Plan Trail Plan Map, included in Appendix A, identifies the existing and planned non-motorized system for the city and surrounding area.

The Snoqualmie Valley Regional Trail bisects the city on a diagonal from southeast to northwest, providing a crushed rock surface, off-street non-motorized trail on the right-of-way of the former Chicago, St. Paul and Pacific Railroad's Everett branch line. This regional trail, maintained by King County, connects the City of Snoqualmie on the northwest to Rattlesnake Lake and the Iron Horse Trail to the southeast. Due to its central location within the City, most city residents can reach this trail within a mile or less. There are also off-street trails (unimproved) along the Middle Fork of Snoqualmie River between 432nd Avenue SE and NE 6th Street, and along the South Fork of the Snoqualmie River from south of the city limit at 436th Avenue SE to Bendigo Boulevard (SR 202).

Existing bicycle lanes (consisting of a paved shoulder, signed and striped for bicycle use) are provided on the following streets:

- Healy Avenue South, Orchard Drive SE to Park Street
- Bendigo Boulevard (SR 202), I-90 to North Bend Way
- SE Cedar Falls Way, North Bend Way to 436th Avenue SE
- North Bend Way, Bendigo Boulevard to the west city limit
- North Bend Way, SE Cedar Falls Way to SE 140th Street
- SE 140th Street, North Bend Way to SE Middle Fork Road
- SE Middle Fork Road, SE 140th Street to the east city limit

- 436th Avenue SE, South Fork Snoqualmie River to North Bend Way (a striped shoulder already exists; this important route lacks only signage, and it is a recommended addition to the 2009 Trail Plan Map, included in Appendix A)

The City's adopted plan recommends bicycle lanes to be added on the following streets:

- NE 6th Street/SE 114th Street, Thrasher Avenue to Middle Fork River Trail
- Pickett Avenue NE, SE 114th Street to the north city limit
- Ballarat/East 4th Street to north city limit
- NE 4th Street, Ballarat to Thrasher Avenue North
- Alm Way, SE North Bend Way to NW 8th Street
- SW Ribary Way, SE 122nd Street to Bendigo Boulevard
- 415th Way SE, Bendigo Boulevard to SE 142nd Street
- 142nd Street, 415th Way SE to the south city limit
- 424th Avenue SE/Maloney Grove Avenue, SE 142nd Street to Cedar Falls Way
- Orchard Drive SE, Healy Avenue S to SE 5th Street
- SE 10th Street, 424th Avenue SE to west of SE 10th Circle
- SE 140th Street, 424th Avenue SE to 432nd Avenue SE
- 432nd Avenue SE, SE140th Street to SE Cedar Falls Way
- SE 136th Street, 436th Avenue SE to east of 440th Place SE
- SE 148th Street/442nd Avenue SE, SE 150th Street to 444th Avenue SE
- 444th Avenue SE, SE 146th Street to SE 144th Street
- SE 144th Street/448th Avenue SE, 444th Avenue SE to SE 145th Street

This system of existing and planned facilities, when completed, will provide a linked network that will serve every city neighborhood.

Walkways

Pedestrian facilities are critical elements of a safe and livable community and include sidewalks, crosswalks, pedestrian overpasses, pedestrian street lighting, design features to enhance the pedestrian environment (e.g., shade trees, benches) and median refuge areas. Pedestrian facilities provide access to people who cannot or do not wish to drive to places of employment, shopping, and other destinations. They also provide important connections to other modes of transportation.

City policy (Transportation Policy 3.1.1) states that "The City should construct pedestrian facilities along all streets…" However, there are city streets that currently lack sidewalks or pathways, and locations where existing facilities do not satisfy current design standards. Some of these inadequate sidewalk facilities were identified by citizens attending the June 9, 2011 Planning Commission Workshop (see Figure 2). In retrofitting existing streets, the City's priority will be to improve pedestrian access to schools, community facilities, commercial areas, employment sites, and other important city destinations along arterial and collector streets before local residential streets. Meanwhile, the City's Design Standards, adopted May 18, 2010 provide for sidewalks along with the construction of all new or improved streets.

In order to facilitate the improvement of pedestrian facilities according to the above-stated priorities, it is recommended that:

- The City annually update its inventory of the pedestrian system, including existing sidewalks, missing sidewalk sections, obstacles and barriers, and the locations of curb ramps and whether or not they comply with applicable ADA design standards; and
- Annually update its Pedestrian Improvement Plan to facilitate programming, funding and construction of pedestrian facilities that address current deficiencies and provide new facilities where there are none.

TRANSPORTATION MANAGEMENT STRATEGIES

Every city in America is facing major challenges in meeting the mobility needs of its citizens, as well as meeting air quality and environmental requirements. There are major transportation issues facing cities today, which typically include: insufficient funds to meet system improvement needs, increased construction costs for new roadway and transit facilities, increased need to improve operational efficiency, changes in travel patterns, lower densities making traditional transit an inefficient option in many areas, freight mobility impacts and need to reduce transportation related air and water pollution.

Transportation management strategies are essential to building an efficient transportation system. These strategies include Transportation System Management (TSM) and Transportation Demand Management (TDM). TSM and TDM are different methodologies for improving the performance and vehicle carrying capacity of existing roadway and transit systems with little or no construction necessary. TSM consists of low-cost capital projects and operational and institutional actions that improve the operating efficiency of both roadway and transit facilities and services. TDM consists of actions that encourage a decrease in the peak hour demand on existing transportation systems. Complementing TSM and TDM strategies is Intelligent Transportation Systems (ITS). ITS consists of the deployment and use of technologies to improve, manage and share information; provide for the integration of transportation services; provide for improved incident response systems; and provide other system management and operational improvements that enhance efficiency and safety. Recent technological advances have made some ITS techniques cost effective for use in small urban and rural areas. The TSM and TDM approaches are discussed in more detail below.

Transportation Demand Management (TDM)

TDM refers to an integrated set of strategies designed to reduce travel, particularly during peak travel times, rather than accommodate it with additional road capacity. TDM includes programs and policies that are designed to maximize the people moving capability of the transportation system by increasing the number of persons in each vehicle via carpool/vanpool, increasing transit use, increasing the use of non-motorized travel options, adopting alternative work arrangements such as telecommuting, or by influencing the timing of, location or need to travel.

TDM is an integral part of the City of North Bend Transportation Plan Update because it potentially addresses several policy needs: mobility, accessibility, traffic congestion, air and water quality, and the desire for a sustainable community. However, TDM is not the only solution. The ability to change travel behavior necessitates an appreciation of the fact that not everyone can use a travel alternative due to the complexity and nature of their daily routines.

As communities such as North Bend grow, the growth in number of vehicles and demand for travel should be accommodated by a combination of road improvements; transit service improvements; bicycle and pedestrian improvements; and a program to reduce travel (vehicle trips and the vehicle miles traveled) via TDM in conjunction with appropriate land use planning.

Within the State of Washington, alternative transportation solutions are further necessitated by the objectives of the Commute Trip Reduction (CTR) Law. Passed in 1991 as a section of the Washington Clean Air Act (RCW 70.94), the CTR Law seeks to reduce workplace commute trips in the nine most populous counties in the State. This law requires that in designated high population counties, each city within the county adopt a commute trip reduction plan requiring private and public employers with 100 or more employees implement TDM programs. Programs provide various incentives or disincentives to encourage use of alternative transportation modes, other than the single occupant vehicle (SOV). The purpose of CTR is to help maintain air quality in metropolitan areas by reducing congestion and air pollution.

The City can support the CTR Law and regional vehicle trip reduction strategies by working with employers to encourage the reduction of SOV commuter use. The City should also encourage King County Metro to enhance transit services in the City and to assist employers in developing plans that meet specific trip reduction needs as required by the CTR Law. Local transit service, such as a plan for a transit shuttle system, should also be pushed ahead. Flex time, parking management, vanpooling and carpooling, walking and biking are some other techniques that should be encouraged.

Transportation System Management (TSM)

TSM refers to a variety of actions and activities designed to make the existing transportation system more efficient. It includes techniques for increasing efficiency, safety, capacity and/or level of service of a transportation facility without major new capital improvements. Actions may include signal improvements, geometric improvements, access management, HOV lanes, ramp metering, incident response, targeted traffic enforcement and programs that enhance transit operations. TSM must account equally for the needs of all modes of travel, and should ensure that bike, pedestrian and transit movements and safety are not compromised in exchange for improving roadway capacity.

Prior to increasing lane capacity on a roadway, the City of North Bend should ensure that existing capacity is utilized at maximum efficiency through the application of TSM investments. These measures may include, but are not limited to the following:

- Roundabouts and traffic circles versus signalization,
- Addition of turn lanes,
- One-way street system,
- Turning movement restrictions,

- Channelization of turning movements,
- Re-striping lanes,
- Raised medians,
- Signalization and signal coordination, and
- Access management strategies.

TSM allows improvement to the transportation system with relatively minimum investments, and is a logical component of a comprehensive, flexible and cost-effective transportation improvement plan.

TRAFFIC CALMING

Many communities in the United States are now exploring further measures beyond sidewalks that place pedestrians and bicyclists on a more even playing field with motorized traffic. These measures, collectively called traffic calming, use physical design of the roadway to reduce automobile speeds. They are not intended for roads where the primary objective is to rapidly move large volumes of traffic, though in some circumstances efforts to slow traffic can actually improve traffic flow. Most often they are used in residential areas where residents see the road as part of their neighborhood; or in downtown shopping districts where creating a pleasant pedestrian environment is critical to maintaining the economic vitality of downtown. The potential benefits of traffic calming include reduced traffic speeds, and reduced traffic volumes, achieved by discouraging "cut-through" traffic on residential streets. Traffic calming techniques also typically improve the aesthetic quality of streets, through landscaping of medians, bump-outs, and traffic circles.

TRANSPORTATION IMPROVEMENT PROGRAM

The City of North Bend current Six-Year Transportation Improvement Program (TIP) for 2012 through 2017 is summarized in Appendix C. The TIP is based on the City's transportation system needs considering both traffic service and maintenance of the physical street structure.

Chapter 4: Roadway Conditions and Level-of-Service

The purpose of this chapter is to describe and assess existing traffic characteristics, and the operational elements of the existing roadway system that include traffic volume, level-of-service and accident analysis.

TRAFFIC VOLUMES

Traffic count data was assembled from several sources, and was supplemented by additional counts taken during April and May of 2011. Historical counts were obtained from King County Public Works, Washington State Department of Transportation, traffic impact study reports provided by the City of North Bend, and additional counts were conducted by TrafStats, Inc. and the City of North Bend. These counts addressed most of the important arterial locations in North Bend, and included 24-hour counts and vehicle classification counts on all the access points to I-90 to provide a detailed hourly breakdown of all vehicles by type (bikes, buses, cars, and trucks by number of axles).

Traffic counts demonstrate a number of variations from year-to-year, over different seasons of the year, hour-by-hour over the 24-hour day, and in the types of vehicles by area of the city. A comparison of traffic counts taken at the same locations in 2003 and in 2011 shows overall fewer vehicles in 2011. This comparison, included in Table 3: Historical Traffic Volume Change, 2003-2011, may reflect economic cycles and altered traffic control features, as well as societal changes such as increased telecommuting and flexible work hours.

Seasonal variations include traffic fluctuations driven by outdoor recreational opportunities in the surrounding mountains—snow sports in the winter and hiking, fishing, etc., in the summer. Spring and fall seasons are thus relatively low times for external traffic. Also, Bendigo Boulevard, serving as access to the Factory Outlet Mall has a pronounced seasonal shopping peak before Christmas.

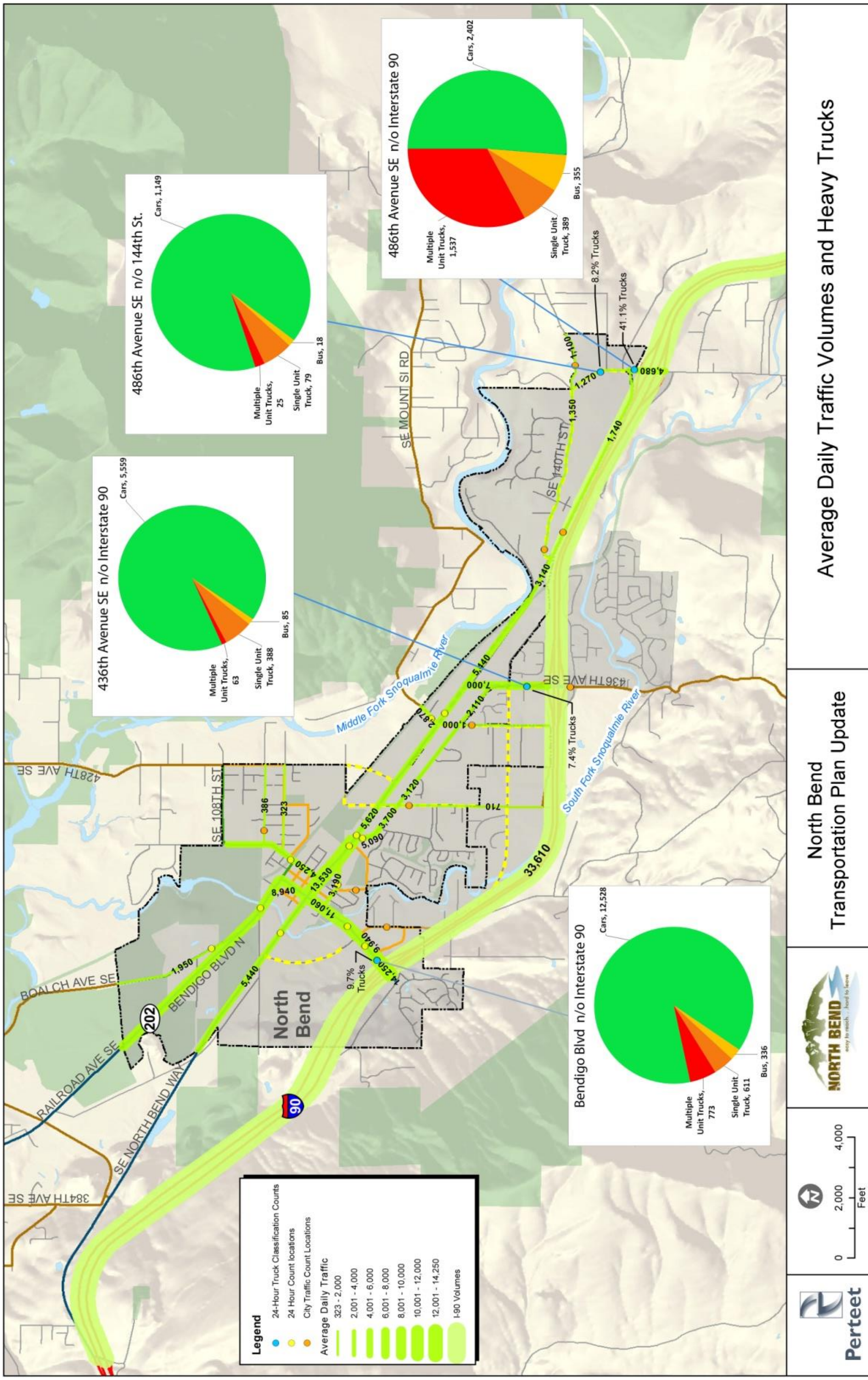
TABLE 3: HISTORICAL PEAK HOUR TRAFFIC VOLUME CHANGE, 2003-2011

Traffic Count Location	Year	Volume	Year	Volume	% Change
Bendigo n/o I-90 WB Ramps	2003	1,547	2011	1,140	-26.3%
Bendigo n/o S. Fork Ave	2003	947	2011	908	- 4.1%
North Bend Way w/o Bendigo	2003	616	2011	519	-15.7%
Park s/o North Bend Way	2003	251	2011	307	22.3%
North Bend Way w/o Cedar Falls	2003	1,348	2011	1,273	-5.6%
North Bend Way e/o Cedar Falls	2003	854	2011	583	-31.7%
Cedar Falls s/o North Bend way	2003	507	2011	517	2.0%
468th St s/o North Bend Way (ADT)	2006	8,623	2011	4,683	-45.7%

The hourly traffic volume in North Bend over a typical day begins very low during the nighttime hours from after 9 PM until 5 AM. Traffic volumes then build to a peak between 7 AM and 9 AM, increase more over the noon hour, and climb through the afternoon to the highest peak of the day between 3 PM and 5 PM. Hourly volumes steadily decline after 5 PM to their nighttime lows. A similar pattern of hourly variation was observed at two different locations on North Bend Way east and west of Downtown, and on Bendigo Boulevard north of I-90.

Average PM peak hour traffic counts are calculated by averaging the traffic counts of a typical work week. Figure 6 shows the afternoon peak hour count volumes collected in Spring 2011, and used for model calibration purposes. It is typical to use the evening peak hour as the basis for analysis purposes since traffic volumes are at their highest levels of the day as described above. The figure shows the highest volumes of traffic along I-90, Bendigo Boulevard and North Bend Way. Also shown on Figure 7 are summaries of vehicle types taken from classification counts by direction of flow at four different locations on Bendigo Boulevard, 436th Avenue SE, and 468th Avenue SE at two spots. Trucks constituted 41.1% of the traffic volume on 468th Avenue SE just north of I-90, compared to 9.7% on Bendigo Boulevard, and 7.4% on 436th Avenue SE. For the purposes of this plan, vehicles reported as trucks include 2-axle vehicles with 6 wheels (single unit delivery-trucks), and vehicles with 3- or more axles, including multi-unit vehicles (typically called "semi-trailers" or "18-wheelers", and "double-bottoms" or "pup trailers and doubles", double trailers that may consist of three or four individual units totaling 7 or more axles).

FIGURE 6: AVERAGE WEEKDAY PM PEAK HOUR TRAFFIC VOLUMES AND HEAVY TRUCKS



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LEVEL OF SERVICE ANALYSIS

Analysis of traffic volumes is useful in understanding the general nature of traffic in an area, but by itself indicates neither the ability of the street network to carry additional traffic nor the quality of service afforded by the street facilities. A qualitative measure describing traffic conditions and the perception of drivers is needed to assess the degree of congestion on a road. Such a measure is referred to as a "level-of-service" (LOS) and is intended to take account of factors such as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience and safety.

Six levels of service are used for describing traffic flow conditions. These are designated from A to F with LOS A representing the best operating condition and LOS F the worst.

Level-of-Service Criteria

Level of service can be measured at intersections and along roadway segments. The *Highway Capacity Manual* (TRB, 2000) provides level of service calculation methodology for both intersections and roadway segments. Intersection LOS is determined by calculating average vehicle delay at the intersection. Table 4 presents the LOS criteria for signalized intersection while Table 5 describes the LOS for all-way or two-way stop-controlled intersections. In urban areas, if signalized intersections are spaced at intervals of one mile or less, the roadway LOS is controlled by the intersection LOS. In rural areas, roadway LOS is controlled by intersection LOS only if signalized intersections are spaced at intervals of two miles or less.

For roadway segments, LOS is calculated by comparing the actual number of vehicles using a roadway (volume of traffic) to its carrying capacity (which is dependent on the number of lanes, the width of the lanes, the presence of on-street parking, etc.). Level-of-service for signalized intersections is determined by the average delay experienced by vehicles at an intersection. Thus, delay at these intersections refers to the average delay experienced by all motorists at the intersection. Table 4 summarizes the LOS criteria for signalized intersections. LOS "D" or better is generally considered to be acceptable and represents 55 seconds or less of delay.

TABLE 4: LOS CRITERIA FOR SIGNALIZED INTERSECTIONS

LOS	Average Delay per Vehicle (seconds/vehicle)
A	≤ 10
B	> 10 – 20
C	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

(Source: Highway Capacity Manual 2000)

For two-way stop-controlled (TWSC) intersections, LOS depends on the amount of delay experienced by drivers on the minor (stop-controlled) approach. For two-way stop controlled unsignalized intersections, "delay" represents the average delay of the worst movement, typically a left turn from the stop-controlled street. All-way stop-controlled (AWSC) intersections require drivers on all approaches to stop before proceeding into the intersection. LOS for AWSC intersections is determined by the average delay for all movements.

The LOS criteria for stop-controlled intersections have different threshold values than those for signalized intersections, primarily because drivers expect different levels of performance from distinct types of transportation facilities. In general, stop-controlled intersections are expected to carry lower volumes of traffic than signalized intersections. Thus for the same LOS, a lower level of delay is acceptable at stop-controlled intersections than it is for signalized intersections. Table 5 summarizes the LOS average delay thresholds for both two-way and all-way stop-controlled intersections. For unsignalized intersections, LOS "E" or better is generally considered to be acceptable, representing 50 seconds or less of delay to motorists.

TABLE 5: LOS CRITERIA FOR ALL-WAY OR TWO-WAY STOP-CONTROL

LOS	Average Delay per Vehicle (seconds/vehicle)
A	≤ 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

(Source: Highway Capacity Manual 2000)

Level-of-Service and Concurrency

Concurrency

Concurrency management ensures that development, in conformance with the adopted land use element of a comprehensive plan, will not cause a transportation facility's LOS to decline below the adopted standard. Concurrency requires transportation system expansion or demand management strategies to offset development impacts. Facilities must be in place or financially planned for within six years of development use.

In order to establish LOS standards for concurrency, the following principles must be considered:

- Ensure adequate facilities to support growth,
- Reinforce development policies,
- Decision-making process that facilitates understanding, administration, and flexibility,
- Strive for maximum uniformity and consistency,
- Enhance transit and non-motorized transportation modes, and
- Ensure financial feasibility.

Existing Intersection Level-of-Service (2011)

Level-of-Service analysis was performed for existing PM peak hour conditions (using the VISUM model). The LOS information, along with the calculated average intersection delay is summarized in Table 6 and illustrated on Figure 7. The results shown in the table represent LOS based upon average delay for all traffic movements at the intersection for signalized and all-way-stop controlled intersections. Thus, there may be longer delays for certain directions of traffic movements than the composite LOS measure shows. A description of the intersections near to or exceeding acceptable operations is provided below. LOS for two-way-stop controlled intersections displays average delay for the worst (or highest delay) minor leg movement. These critical movements are shown in Table 6.

Of the twenty-one intersections in Table 6, 18 are operating within the City of North Bend's acceptable standard at LOS D or better, two below the standard, and one was not analyzed. The signalized intersection at North Bend Way/Bendigo Boulevard is operating at LOS D. The critical movement is westbound left turns on North Bend Way, which backs up queues through Downtown.

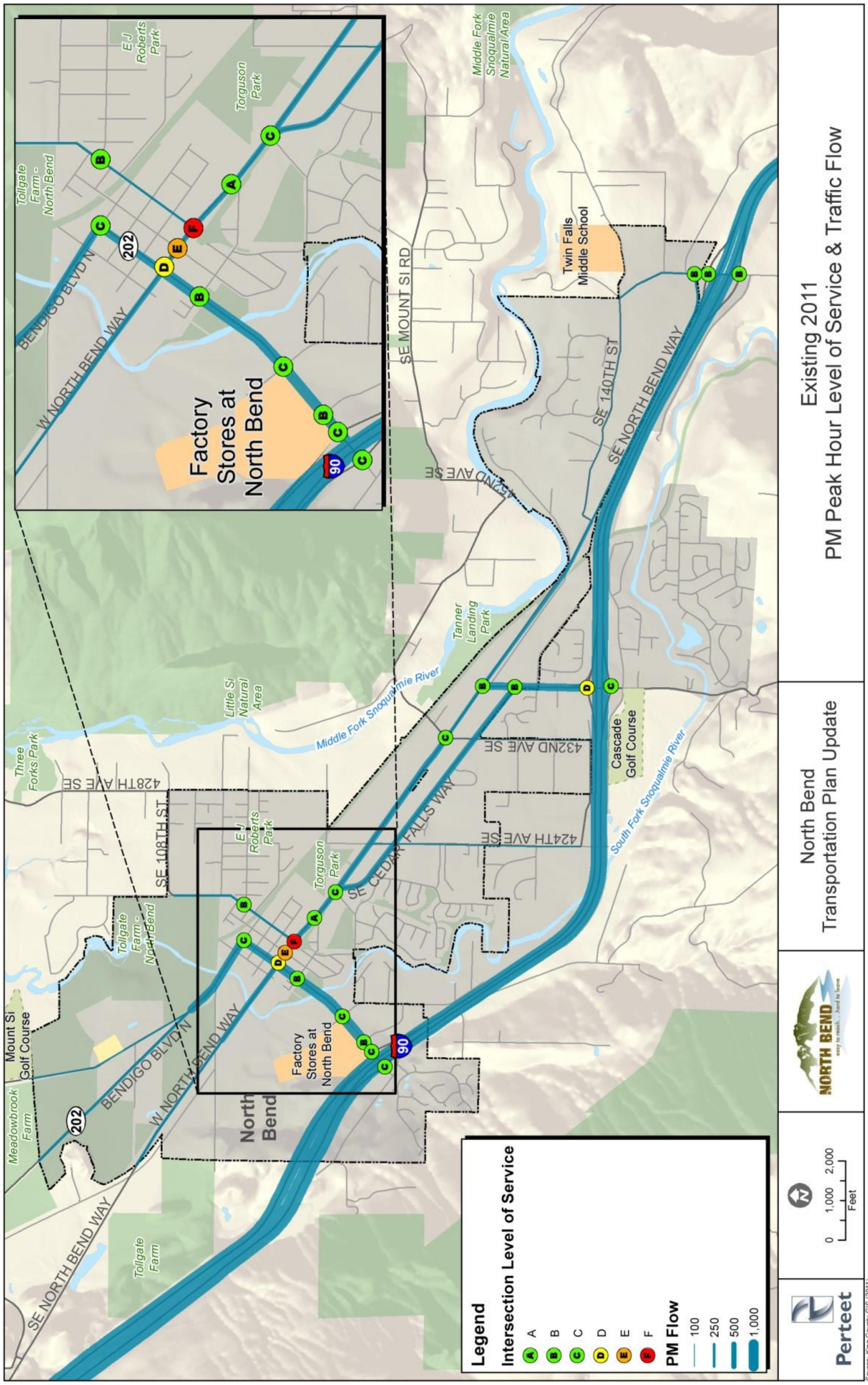
Two unsignalized intersections are operating below the standard: The southbound left-through movement is a LOS F at the intersection of North Bend Way/Ballarat; and the northbound left turn at North Bend Way/Main is an LOS E. The remainder of the intersections that were analyzed currently operate at LOS D or better. It is not uncommon for the minor legs at a stop controlled intersection to experience LOS E or F conditions during the peak hour in an urbanized area. Both of the two roundabouts are operating acceptably at LOS C.

TABLE 6: EXISTING WEEKDAY PM PEAK HOUR LEVELS OF SERVICE

	Intersection		Traffic Control[1]	Critical Movement[2]	Delay[3]	LOS[4]
	Primary Leg	**Secondary Leg**				
1	North Bend Way W	Main Avenue	TWSC	NB-L (LOS E)	49.9	**E**
2	North Bend Way E	Ballarat Avenue	TWSC	SB-LT (LOS F)	80.7	**F**
3	North Bend Way E	Park Street	TWSC	NB-LR (LOS C)	17.4	C
4	North Bend Way E	SE Cedar Falls Way	Roundabout	EB-LTR (LOS D)	19.6	C
5	North Bend Way W	Bendigo Boulevard	S	WB-L (LOS F)	39.5	D
6	North Bend Way E	SE Mt. Si Road	TWSC	EB-LTR (LOS C)	16.2	C
7	North Bend Way E	436th Ave SE	TWSC	NB-LR (LOS B)	13.3	B
8	North Bend Way E	468th Ave SE	TWSC	EB-LR (LOS B)	11.7	B
9	Bendigo Boulevard	Park Street	S	WB-LTR (LOS C)	13.9	B
10	Bendigo Boulevard	South Fork Avenue	S	SB-L (LOS D)	25.5	C
11	Bendigo Boulevard	Mount Si Boulevard	S	NB-L (LOS C)	16.9	B
12	Bendigo Boulevard	I-90 WB Ramp	TWSC	NB-LTR (LOS C)	21.7	C
13b	Bendigo Boulevard	I-90 EB Ramp	Roundabout	SB-LTR (LOS D)	21.6	C
14	Bendigo Boulevard	4th Street	TWSC	WB-L (LOS C)	17.5	C
15	Park Street	Main Avenue	AWSC	NA	NA	NA
16	Ballarat Avenue	6th Street	TWSC	WB-LR (LOS B)	10.1	B
17	436th Ave SE	I-90 WB Ramp	TWSC	WB-LT (LOS D)	32.4	D
18	436th Ave SE	I-90 EB Ramp	TWSC	EB-LTR (LOS C)	24.3	C
19	436th Ave SE	SE Cedar Falls Way	TWSC	EB-LR (LOS B)	10.4	B
20	468th Ave SE	I-90 WB Ramp	TWSC	WB-LT (LOS B)	12.7	B
21	468th Ave SE	I-90 EB Ramp	TWSC	EB-LT (LOS B)	12.1	B

1. *S=signalized intersection, TWSC=two-way stop-control (at the secondary leg), AWSC=all-w ay stop-control*
2. *NB=Northbound, SB=Southbound, EB=Eastbound, WB=Westbound, L=Left, LR=Left and Right Movements, LRT=Left, Through, and Right Movements*
3. *Delay is measured in seconds per vehicle. At signalized (S) and AWSC intersections, it represents average delay for all intersection movements. For TWSC intersections, it represents average delay for the worst minor leg movement.*
4. *Level-of-Service based on the methodology outlined in the 2000 Highway Capacity Manual*
5. *The intersections in lines 20 and 21 are currently outside the City limits and the data are provided for informational purposes only. These intersections are to be monitored and revaluated when annexed into the City.*

FIGURE 7: WEEKDAY PM PEAK INTERSECTION LOS-BASE YEAR (2011)



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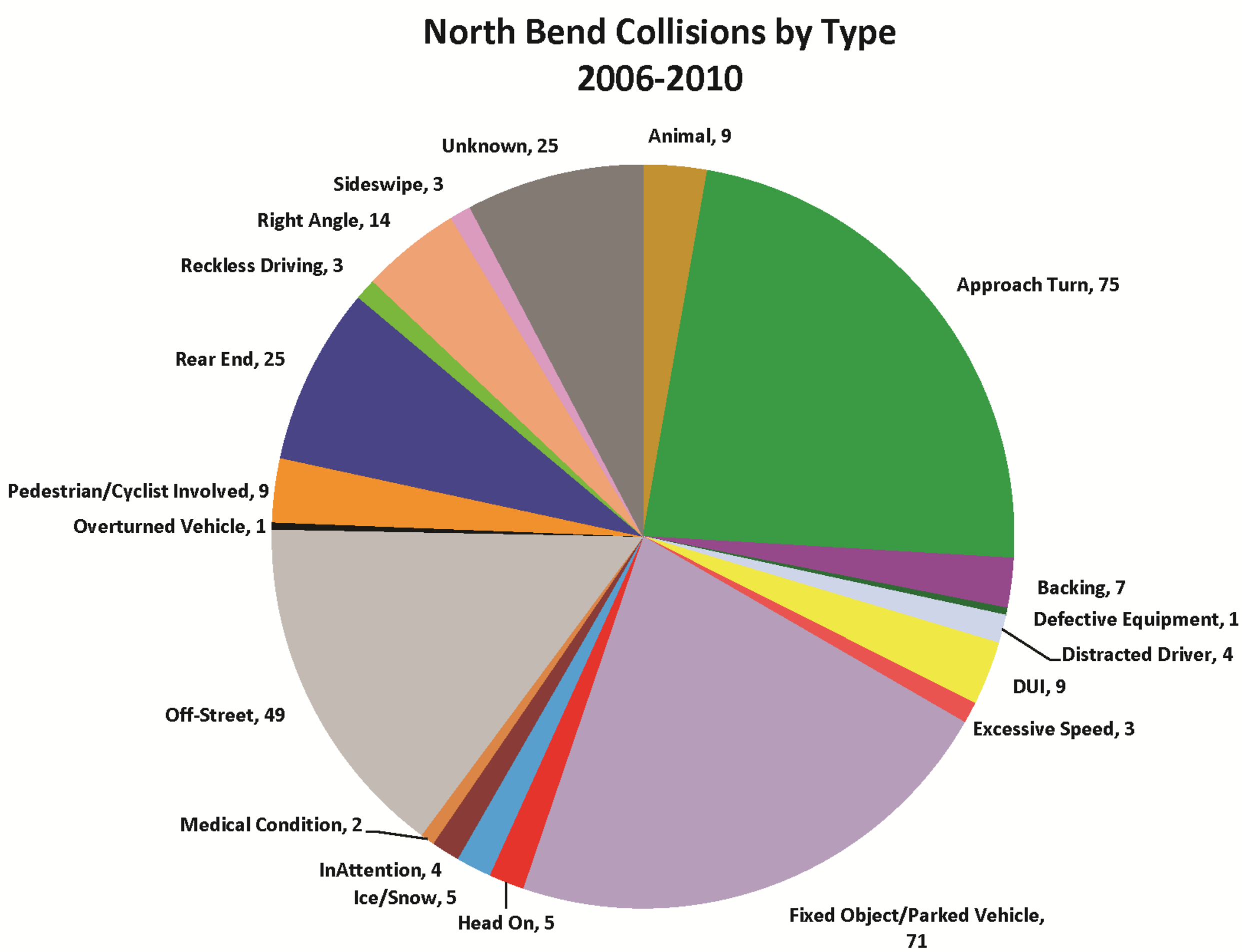
ACCIDENT ANALYSIS

Collision data was obtained from the City of North Bend for a five year recording period. Data covered collisions occurring between January 01, 2006 and December 31, 2010. During this period 275 collisions occurred on North Bend streets and 49 collisions occurred on private, off-street property, for a total of 324 vehicular collisions. A chart showing the number of collisions by type is shown below in Figure 8.

FIGURE 8: NORTH BEND COLLISIONS BY TYPE 2006-2010



Intersections with one or more collisions per year are summarized in Table 7 and the locations are illustrated on Figure 9.

For analysis purposes, collision data was converted to a collision rate to compare high and low volume intersections on an equal basis. Intersection collision rates are expressed in Table 7 as collisions per million entering vehicles (MEV). The following equation was used to determine the intersection collision rate using the City's 2009-2010 24-hour traffic count volumes:

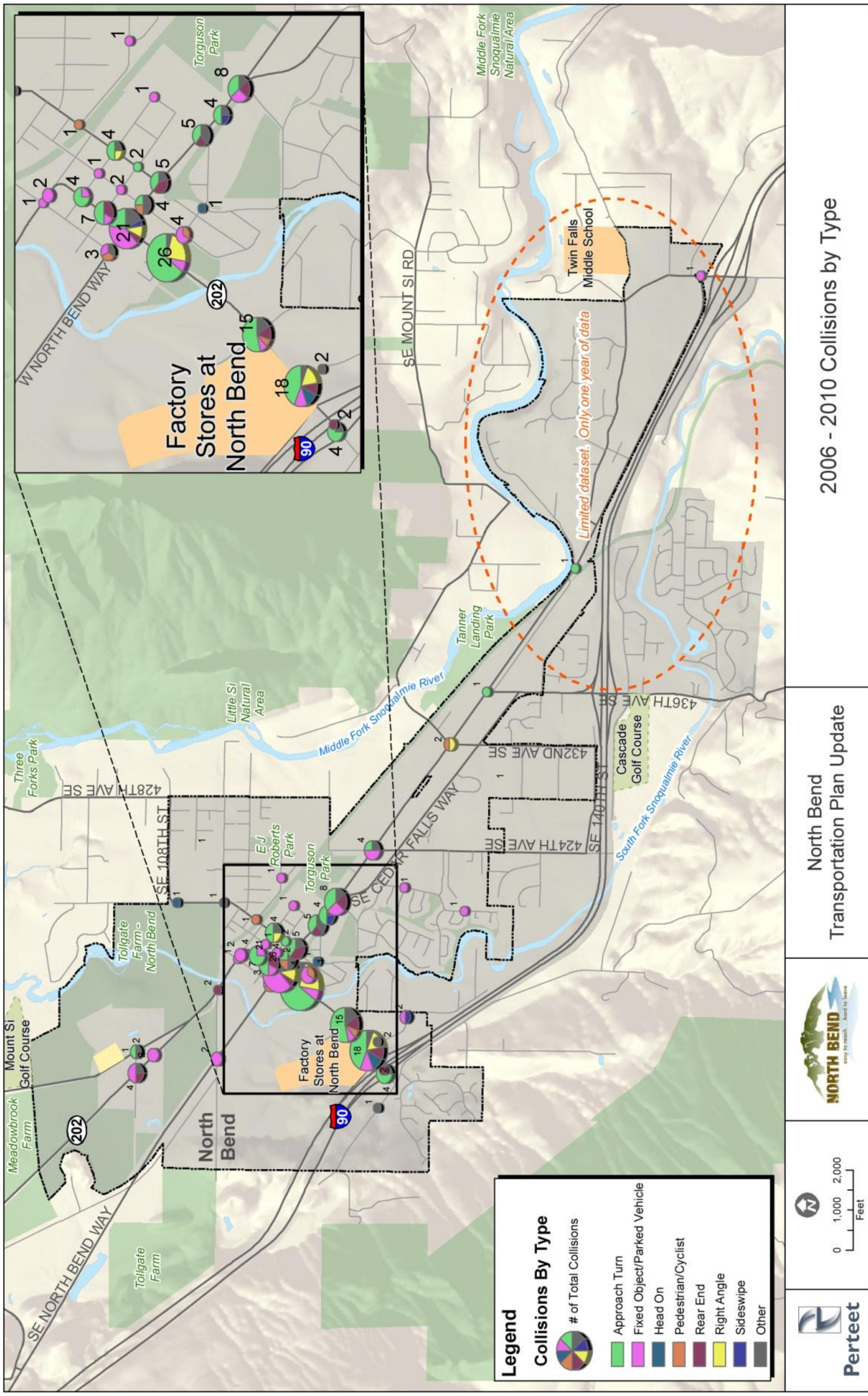
$$\text{Collision Rate} = \frac{\text{Annual number of collisions x 1,000,000}}{\text{Vehicles Entering Intersection per day x 365 days / year}}$$

TABLE 7: COLLISION HISTORY, 2006-2010 (INTERSECTIONS AVERAGING ONE OR MORE COLLISIONS PER YEAR)

Intersections	Total # Collisions	2006	2007	2008	2009	2010	Collisions per MEV
Bendigo Blvd at W. Park Street	26	11	11	3	1	0	1.15
Bendigo Blvd at North Bend Way	21	8	7	1	3	2	0.63
Bendigo Blvd at SW Mount Si Blvd	18	1	2	4	5	6	0.58
Bendigo Blvd at South Fork Ave SW	15	4	3	0	2	6	0.71
E North Bend Way at SE Cedar Falls Way	8	1	3	1	2	1	0.47
Bendigo Blvd at W. 2nd Street	7	0	3	0	3	1	0.53
E North Bend Way at Ballarat Avenue	5	1	0	1	3	0	0.20
E North Bend Way at E. Park Street	5	0	2	3	0	0	0.21

A collision rate of 1.0 collision per MEV or lower is typically considered acceptable. As shown in Table 7, all but one of the listed intersections experienced collisions at a rate below the suggested 1.0 rate criteria. The highest collision rate documented occurred at the intersection of Bendigo Boulevard and W. Park Street where the 26 total collisions produced a rate of 1.15 collisions per MEV. Twenty-two of the collisions (85%) were approach turn (16) or right angle (8) type collisions, which are of concern due to a high potential for injuries. There has been a significant decline in collisions at this intersection since completion of the signalization project in 2008.

FIGURE 9: ACCIDENT LOCATIONS: 2006-2010



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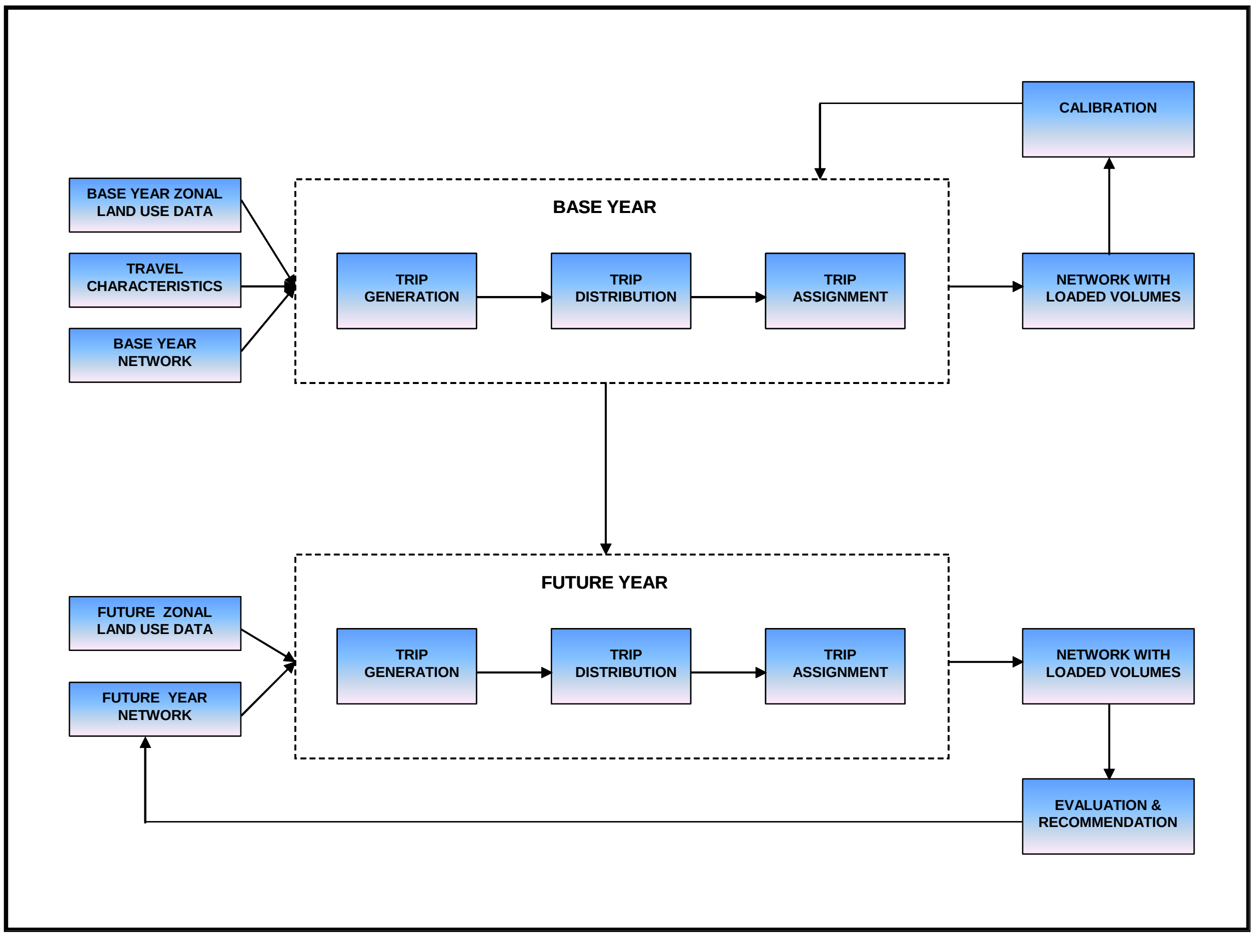
Chapter 5: Traffic Forecast Summary

The purpose of this chapter is to present the methodology used to forecast transportation conditions through the 2030 planning horizon, and assess those future transportation conditions.

TRAFFIC FORECASTING METHOD

For the *City of North Bend Transportation Element*, a computerized travel demand model was updated and recalibrated to predict the afternoon peak-hour volume and assess the future transportation conditions. Figure 10 outlines the major components of the traffic forecasting process. Appendix D details the technical aspects of the model.

FIGURE 10: DEVELOPMENT AND APPLICATION OF TRAVEL FORECASTING MODELS



DEVELOPMENT AND APPLICATION OF TRAVEL FORECASTING MODELS

The travel demand forecasting model developed for the City of North Bend used PTV Vision VISUM version 11.52+. This more modern software served as an update of the previously used TMODEL2 software and was able to import all of the previous model files. Both TMODEL2 and now PTV Vision VISUM have been used by many cities in the state of Washington. The model follows the standard four-step process, with the exception that the modal choice step is omitted as only trips via the private automobiles are considered. The level of transit service in the City makes the proportion of transit trips insignificant compared to auto trips. Trips via other alternatives, such as paratransit and non-motorized modes, are also very limited. Forecasts of future year traffic volumes can be developed with this model by entering new data for assumed future road conditions and land use scenarios.

Geographic Scope and Traffic Analysis Zones

The study area includes the City of North Bend, its Urban Growth Area and some surrounding areas, such as the occupied residential land area of the Upper Snoqualmie Valley and tributaries. The adjacent City of Snoqualmie is not included in the model, but Snoqualmie traffic is included in the external zone representing SR 202 at the northwest edge of the model area.

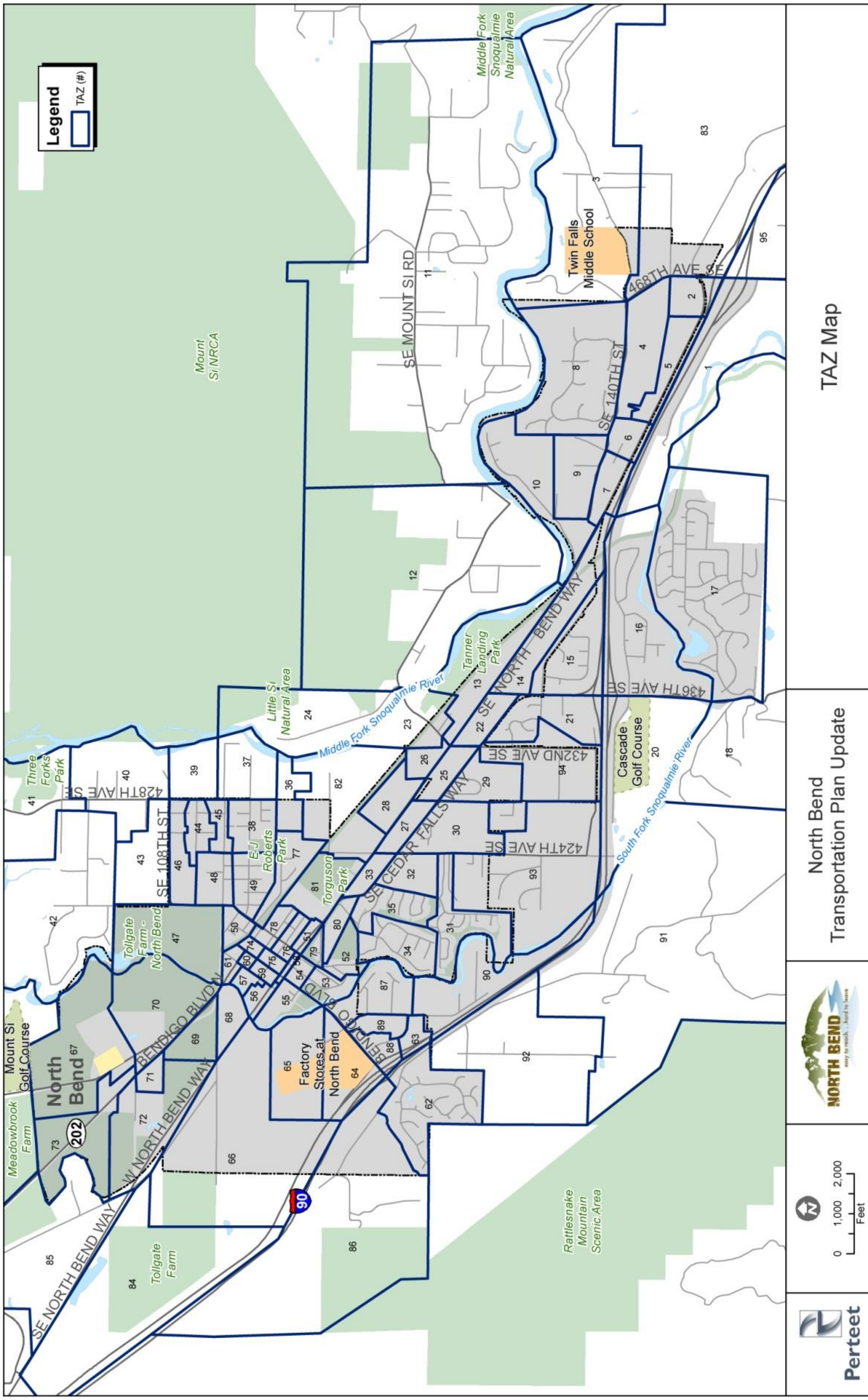
The study area depicted previously in Figure 1 was divided into 99 transportation analysis units to enable the linking of information about activities, travel, and transportation to physical locations in the study area. These transportation analysis units are better known as Traffic Analysis Zones (TAZs). The TAZ boundaries for the North Bend Study Area are shown in Figure 11. The small-size TAZs are used to detail the City of North Bend and the area of high interests. In more distant areas, there is progressively less detail, and the TAZs are larger. The TAZs attempt to bound homogeneous urban activities; that is, a zone may be all residential, all commercial, all industrial, etc. TAZs also consider natural boundaries, census designations, and highway and administration boundaries. It is more important that a TAZ represent an area defined by its accessibility thanby its homogenous land use.

Model Network

The arterial street system is coded into the computer model network by using links to represent roadways and nodes to represent the roadway intersections. In a travel demand model, trips of each TAZ begin and end on the so-called "centroid", which is considered the central point of activities in the TAZ. These centroids are defined for each TAZ in the model and are connected to nodes in network by "centroid connectors". To form a functional model network, all links and nodes should be attributed by functional classification (designated in the model by Type), length, capacity, speed and other attributes.

The North Bend model network details the city area and some high-interest areas with all interstates, arterials, collectors as well as many local access roads. In more distant areas, there is progressively less detail, with fewer collectors and minor arterials (if any). At the outer area with less interest only freeways and selected principal arterials are included.

FIGURE 11: TRAFFIC ANALYSIS ZONES FOR THE NORTH BEND STUDY AREA



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The updated 2011 base year model consists of 99 internal TAZs and 9 external stations, 1056 directional links, 499 nodes, and 286 centroid connectors.

Trip Generation

This step addresses the question, how much travel is made in a TAZ during the peak hour? These trips ends (better known as zonal productions and attractions) are estimated using assumptions about the number of trips typically made by or attracted to each type of land use type. Thus, the trip generation process translates land use quantities (number of dwelling units, employees, etc.) into vehicle trip ends (number of vehicles entering or leaving a TAZ) using appropriate trip generation rates. Because trips made for different purposes have different trip distributions, trip generation results are often stratified into purposes, such as home to work or home to shop or home to school. This categorization is necessary because each trip purpose reflects the behavior of the trip maker. For example, school trips and work trips are fairly regular compared to shopping and recreational trips. Moreover, work trips are usually longer with minimal daily choice to change destinations, while shopping trips are generally shorter and more easily changed.

For this model update, trips are stratified into six directional "trip purposes" to more accurately describe peak hour travel. The additional trip purposes are used to subdivide trips by direction of travel, and to explicitly model "chained trips" involving more than one stop.

1. From Work to Home with no stops (A-WH).
2. From Work to Other for the first part of "chained" trips en route home; for shopping, etc. (B-WK-DVT).
3. From Other to Home for concluding part of "chained" trips en route home (C-DVT-HM).
4. From Home to Other, predominantly to retail shopping, and other local destinations (D-HM-OTH).
5. From Other to Home for the return part of local home-to-other trips (E-OTH-HM).
6. Non-Home-Based for trips between two TAZ's which do not include the driver's residence. This accounts for several types of trips including second- or third- legs of a multi-stop tour of "chained" trips, commercial travel of all types, and truck travel (F-NHB).

Zonal trip productions and attractions by purpose are derived by applying the average generation rates for each land use described in Table 1. The absence of data from travel surveys in the study area justified the use of average generation rates from the 7th edition of the ITE Trip Generation Handbook. Trip generation rates for this model update were imported from the previous model dataset but were not revised. Details of the rates used for the PM peak model is given in the technical documentation in Appendix D.

Trip Distribution

This step of the model process estimates the number of travel from one TAZ in the model to any other TAZ. Distribution is accomplished through use of the gravity model technique, which distributes trips according to two basic assumptions: (1) more trips will be attracted to larger zones (the size of a zone is defined by the number of attractions estimated in the trip generation phase, not the geographical size), and (2) more trip interchanges will take place between zones that are closer together than the number that will take place between zones that are farther apart. The second assumption is usually measured in terms of travel impedance, i.e., more trip interchanges occur between zones that have the least impedance to travel. Interzonal travel impedance is measured as a weighted average of (predominantly) travel time and (modestly) travel distance between each pair of TAZs.

Network Assignment

This information is then used to determine the optimum path between all pairs of TAZs based on some measure of travel cost. Using assignment algorithms the route choices of individual drivers are simulated. Given the number of trip interchanges between zone pairs, the assignment algorithm predicts the best (usually cheapest route) for each driver. The route choice decision is usually represented by the cost involved, where cost is either time or distance, or a combination of both. Usually, travel time is used as a cost measure. If distance component is included, it usually is just a small fraction.

In this process, trips from one zone to another are assigned to specific travel routes in the network, and resulting trip volumes are accumulated on links of the network until all trips are assigned. Network travel times are updated to reflect the congestion effects of the traffic assigned through an incremental assignment process. Congested travel times are estimated using some form of travel impedance functions (better known as "volume/delay functions") that has direct relationship with traffic volumes. There are different forms of volume/delay functions, all of which attempt to simulate the impact of congestion on travel times (greater delay) as traffic volume increases. The volume-delay functions take into account the specific characteristics of each roadway link, such as capacity, speed and facility type. This allows the model to reflect conditions somewhat similar to driver behavior.

Model Calibration and Validation

No traffic model is ever totally accurate, due to the practical limitations of input data (incomplete or inaccurate counts, land use, road network data, etc.) as well as the complexity and diversity of human travel decisions. **Calibration** of a traffic model consists of adjusting internal formulae and parameters to achieve a good representation of actual base year traffic from the inputs of base year land use and road data. **Validation** is the process of comparing traffic model outputs to traffic counts and other data, to verify reasonable operation according to available standards of reference. Once the model is calibrated and validated for existing conditions, it can be used as the basis for analyzing future traffic conditions, as well as potential improvements to address existing and future deficiencies. Details of calibration and validation of the North Bend base year model are included in the technical documentation in Appendix D.

Model of Future Traffic Conditions

Using the same general process described for modeling existing conditions, the forecasted land use data is used to estimate the number of trips that will be generated in future travel. These trips are then distributed among the TAZs, and assigned to the street network. The result is model of projected future traffic conditions, under the expected future land use scenario.

Intersection LOS for 2030 No Action Conditions

The forecast traffic operating conditions in 2030 are shown in Table 8 for the same 21 intersections that were identified for existing 2011 conditions, assuming no major changes to the roadway network will occur. As indicated in Table 8, seven intersections are forecast to operate with LOS E or F conditions below the City's LOS standard. This is an increase from two in existing conditions, reflecting greater congestion as a result of land use change. The seven intersections that are projected below LOS D conditions in 2030 include:

- North Bend Way/Main Avenue
- North Bend Way/Ballarat Avenue
- North Bend Way/Bendigo Boulevard
- North Bend Way/SE Mt. Si Road
- Bendigo Boulevard/I-90 WB ramp
- 436th Avenue SE/I-90 WB ramp, and
- 436th Avenue SE/I-90 EB ramp

The forecast average delay for motorists at three of the North Bend Way intersections is at about 7 minutes, which will be unacceptable to most motorists. The projected average delays at the 436th Avenue SE ramps to I-90 will be at about 3 minutes. It will be necessary to identify solutions to address these problems to bring the LOS into compliance with the City's adopted LOS standard and to reduce frustration for roadway users that can lead to collisions and other problems. Solutions may include adding dedicated turn lanes, signalization, or diverting traffic to other streets.

While growing traffic volume is expected to cause greater intersection delay generally, all of the remaining intersections are projected to operate at LOS D or better, satisfying the City's adopted LOS standard.

TABLE 8: 2030 BASE (NO CHANGE) WEEKDAY PM PEAK HOUR LEVELS OF SERVICE

	Intersection		Traffic Control[1]	Critical Movement[2]	Delay[3]	LOS[4]
	Primary Leg	Secondary Leg				
1	North Bend Way W	Main Avenue	TWSC	NB-L (LOS F)	435.3	**F**
2	North Bend Way E	Ballarat Avenue	TWSC	SB-LT (LOS F)	407.1	**F**
3	North Bend Way E	Park Street	TWSC	NB-LR (LOS C)	17.9	C
4	North Bend Way E	SE Cedar Falls Way	Roundabout	EB-LTR (LOS E)	31.1	D
5	North Bend Way W	Bendigo Boulevard	S	SB-LTR (LOS F)	451.6	**F**
6	North Bend Way E	SE Mt. Si Road	TWSC	WB-LTR (LOS F)	61.2	**F**
7	North Bend Way E	436th Ave SE	TWSC	NB-LR (LOS D)	32.8	D
8	North Bend Way E	468th Ave SE	TWSC	EB-LR (LOS C)	15.8	C
9	Bendigo Boulevard	Park Street	S	WB-LTR (LOS C)	17.4	B
10	Bendigo Boulevard	South Fork Avenue	S	EB-L (LOS D)	22.9	C
11	Bendigo Boulevard	Mount Si Boulevard	S	NB-L (LOS C)	16.0	B
12	Bendigo Boulevard	I-90 WB Ramp	TWSC	NB-LTR (LOS E)	38.0	**E**
13b	Bendigo Boulevard	I-90 EB Ramp	Roundabout	SB-LTR (LOS D)	19.9	C
14	Bendigo Boulevard	4th Street	TWSC	WB-L (LOS D)	31.9	D
15	Park Street	Main Avenue	AWSC	N/A	N/A	N/A
16	Ballarat Avenue	6th Street	TWSC	WB-LR (LOS B)	11.2	B
17	436th Ave SE	I-90 WB Ramp	TWSC	WB-LT (LOS F)	193.5	**F**
18	436th Ave SE	I-90 EB Ramp	TWSC	EB-LTR (LOS F)	156.9	**F**
19	436th Ave SE	SE Cedar Falls Way	TWSC	EB-LR (LOS B)	13.4	B
20	468th Ave SE	I-90 WB Ramp	TWSC	WB-LT (LOS B)	13.3	B
21	468th Ave SE	I-90 EB Ramp	TWSC	EB-LT (LOS B)	14.3	B

1. *S=signalized intersection, TWSC=two-way stop-control (at the secondary leg), AWSC=all-way stop-control*
2. *NB=Northbound, SB=Southbound, EB=Eastbound, WB=Westbound, L=Left, LR=Left and Right Movements, LRT=Left, Through, and Right Movements*
3. *Delay is measured in seconds per vehicle. At signalized (S) and AWSC intersections, it represents average delay for all intersection movements. For TWSC intersections, it represents average delay for the worst operating minor leg movements.*
4. *Level-of-Service based on the methodology outlined in the 2000 Highway Capacity Manual*
5. *The intersections in lines 20 and 21 are currently outside the City limits and the data are provided for informational purposes only. These intersections are to be monitored and revaluated when annexed into the City.*

Chapter 6: System Analysis

The purpose of this chapter is to summarize the existing and future transportation issues that must be addressed, and identify various potential improvements that may correct current and future deficiencies in the system.

SUMMARY OF OPERATIONS ANALYSIS

In the existing (2011) conditions, the City has four signalized intersections and two roundabouts. The rest of the intersections are controlled by two-way stop and four-way stop signs. The signalized intersection at North Bend Way/Bendigo Boulevard is currently operating at LOS D (at the standard) and the other signalized intersections operate at LOS C or better. Both roundabouts are operating at LOS C. Two stop-controlled intersections that are currently below the LOS standard are North Bend Way/Ballarat and North Bend Way/Main. The other unsignalized intersections in the City are operating at LOS D or better.

Analysis shows that the projected future development by 2030 and resulting growth in population and employment will cause increased traffic congestion at intersections on the City's street system. The number of intersections that will operate below LOS standards is projected to increase from two to seven by 2030. Traffic congestion is projected to be most heavy along the North Bend Way corridor from Bendigo Boulevard to Cedar Falls Way, Bendigo Boulevard at the I-90 WB ramp, and 436th Avenue SE at the I-90 interchange. In addition, special attention to heavy truck movements in the vicinity of the 468th Avenue SE corridor will be necessary from I-90 to SE 144th Street.

Four major intersection improvements are included in the 2012-2017 Six-Year TIP (Appendix C):

1. The installation of a roundabout at North Bend Way/Park Street along with a median on North Bend Way is needed to control turning movements from Park Street, Downing Avenue, and major commercial driveways (QFC) in the vicinity. Although the collision history (see Table 7) does not indicate a high accident rate, observed turning movements at this location suggest a problem.
2. The installation of a dedicated right turn lane for northbound Bendigo Boulevard to Park Street would encourage northbound traffic on Bendigo Boulevard that intends to go east on North Bend Way to avoid that congested intersection.
3. The intersection of W. North Bend Way/NW 8th Street requires improvement prior to the planned extension of South Fork Avenue from Bendigo Way to W. North Bend Way (Nintendo By-Pass) to address limited sight-distance and angle of approach problems that could contribute to a safety problem. Turn lanes may be needed for the approach.
4. The installation of a traffic signal at the intersection of E. North Bend Way/Ballarat will not be needed, given other completed or planned improvements – the recent completion of the Downing Avenue extension from E. North Bend Way to E. 2nd Street, the planned roundabout at E. North Bend Way/Park/Downing, and the planned Downtown Plaza improvements.

The intersections that would experience the greatest deterioration in level of service that need to be addressed by future improvements (in addition to projects in the TIP) are:

- Bendigo Boulevard/North Bend Way, which is predicted to operate at LOS F in 2030;
- 436th Avenue SE/I-90 Eastbound and Westbound Ramps, both of which are forecast for LOS F conditions on the ramp approaches in 2030;
- E. North Bend Way at Main and Ballarat Avenues, both of which have forecast LOS F conditions on the stop-controlled approaches during the peak hour;
- E. North Bend Way/SE Mt. Si Road, which serves heavy recreational demand during the warmer months, has forecast LOS F conditions on the stop-controlled approach.

A number of potential improvements have been identified to relieve existing and projected congestion at the Bendigo Boulevard/North Bend Way intersection, including:

- The South Fork Avenue Extension from Bendigo to W. North Bend Way at NW 8th Street, which is projected to attract nearly 500 trips in the PM peak hour;
- The construction of a dedicated right turn lane for the northbound approach from Bendigo Boulevard to Park;
- The reconfiguration of the Bendigo/NE 4th Street intersection, removing the diverter to allow east-west movements, potentially adding a traffic signal or a roundabout;
- Construction of the proposed roundabout and median improvements at E. North Bend Way/Park/Downing;
- Implementation of the Downtown Plaza improvements on E. North Bend Way from Bendigo to Park;
- Constructing the Pickett Avenue Extension from E. North Bend Way to NE 6th Street is projected to attract 240 vehicle trips in the PM peak hour; and
- Extending a new east-west roadway on the approximate alignment of South Fork Avenue/SE 20th Street, from Mt. Si Boulevard to 436th Avenue SE, would attract 340 vehicle trips in the PM peak hour, relieving both Cedar Falls Way and North Bend Way.

OPERATIONS FOR 2030 RECOMMENDED PLAN CONDITIONS

A traffic forecast using the North Bend Travel Model was completed for planned 2030 land use conditions, with all the identified potential roadway improvements in place. Projected intersection LOS conditions are shown in Table 9. The assumed roadway improvements for the planned 2030 network included:

- The South Fork Avenue Extension from Bendigo to W. North Bend Way at NW 8th Street;
- The Pickett Avenue Extension from E. North Bend Way to NE 6th Street;
- Removal of the diverter at Bendigo/NE 4th Street;
- Implementation of the Plaza Project on North Bend Way between Bendigo and Ballarat, with an assumed roundabout at North Bend Way/Ballarat;
- Implementation of a roundabout at North Bend Way/Park/Downing; and

- South Fork Avenue/SE 20th Street Extension, Mt. Si Boulevard to 436th Avenue SE with new development.

TABLE 9: 2030 RECOMMENDED IMPROVEMENTS WEEKDAY PM PEAK HOUR LEVELS OF SERVICE

	Intersection		Traffic Control[1]	Critical Movement[2]	Delay[3]	LOS[4]
	Primary Leg	Secondary Leg				
1	North Bend Way W	Main Avenue	TWSC	SB-L (LOS C)	17.7	C
2	North Bend Way E	Ballarat Avenue	Roundabout	WB-TR (LOS B)	9.5	A
3	North Bend Way E	Park Street	Roundabout	EB-LR (LOS B)	10.4	B
4	North Bend Way E	SE Cedar Falls Way	Roundabout	EB-LTR (LOS C)	16.0	C
5	North Bend Way W	Bendigo Boulevard	S	WB-L (LOS B)	14.2	B
6	North Bend Way E	SE Mt. Si Road	TWSC	WB-LTR (LOS E)	42.4	**E**
7	North Bend Way E	436th Ave SE	TWSC	NB-LR (LOS E)	43.1	**E**
8	North Bend Way E	468th Ave SE	TWSC	EB-LR (LOS C)	16.4	C
9	Bendigo Boulevard	Park Street	S	WB-LTR (LOS C)	12.7	B
10	Bendigo Boulevard	South Fork Avenue	S	SB-L (LOS D)	27.1	C
11	Bendigo Boulevard	Mount Si Boulevard	S	NB-L (LOS C)	15.8	B
12	Bendigo Boulevard	I-90 WB Ramp	TWSC	NB-LTR (LOS E)	47.6	**E**
13	Bendigo Boulevard	I-90 EB Ramp	Roundabout	SB-LTR (LOS E)	28.2	D
14	Bendigo Boulevard	4th Street	Roundabout	WB-T (LOS B)	8.6	A
15	Park Street	Main Avenue	AWSC	N/A	N/A	N/A
16	Ballarat Avenue	6th Street	TWSC	WB-LR (LOS A)	9.8	A
17	436th Ave SE	I-90 WB Ramp	TWSC	WB-LT (LOS F)	91.9	**F**
18	436th Ave SE	I-90 EB Ramp	TWSC	EB-LTR (LOS E)	42.1	**E**
19	436th Ave SE	SE Cedar Falls Way	TWSC	EB-LR (LOS B)	12.7	B
20	468th Ave SE	I-90 WB Ramp	TWSC	WB-LT (LOS B)	13.3	B
21	468th Ave SE	I-90 EB Ramp	TWSC	EB-LT (LOS B)	14.4	B

1. *S=signalized intersection, TWSC=two-way stop-control (at the secondary leg), AWSC=all-way stop-control*
2. *NB=Northbound, SB=Southbound, EB=Eastbound, WB=Westbound, L=Left, LR=Left and Right Movements, LRT=Left, Through, and Right Movements*
3. *Delay is measured in seconds per vehicle. At signalized (S) and AWSC intersections, it represents average delay for all intersection movements. For TWSC intersections, it represents average delay for the worst operating minor leg movement.*
4. *Level-of-Service based on the methodology outlined in the 2000 Highway Capacity Manual*
5. *The intersections in lines 20 and 21 are currently outside the City limits and the data are provided for informational purposes only. These intersections are to be monitored and revaluated when annexed into the City.*

The conclusion to be drawn from the system analysis summarized in Table 9 is that the recommended improvements would solve much of the projected 2030 congestion that would otherwise occur with no changes in the 2030 Base Network (Table 8). The combination of the proposed new roadway extensions (at South Fork and Pickett Avenues especially) and assumed completion of the Downtown Plaza project, with new roundabouts on North Bend Way in the Downtown core area, would:

a. Provide alternative routes for trips to avoid Downtown if they don't have a destination there;
b. Provide alternative routes that would allow a faster travel time than North Bend Way through Downtown; and
c. Improve the LOS on several Downtown intersections to achieve the City's standard of LOS D or better, including North Bend Way/Bendigo Boulevard, which would improve from LOS F (Table 8) to LOS B (Table 9).

The remaining intersections projected to operate at LOS E or LOS F in 2030 are:

- North Bend Way/SE Mt. Si Road (LOS E),
- North Bend Way/436th Avenue SE (LOS E),
- Bendigo Boulevard/I-90 westbound ramp (LOS E),
- 436th Avenue SE/I-90 westbound ramp (LOS F), and
- 436th Avenue SE/I-90 eastbound ramp (LOS E).

All the above intersections are two-way stop-controlled intersections, which are projected for lengthy delays on the minor approach leg. In all cases, the major arterial legs are projected to operate with a good LOS (of C or better). Notably, the 436th Avenue SE corridor accounts for three of the five projected poorly performing intersections. Traffic growth is expected in this corridor because it serves new development and provides a convenient route to/from I-90. While it is not uncommon to accept a poor level of service on the minor approach in similar stop-controlled situations, a careful analysis of corrective measures should be conducted as traffic volumes build over time. The highest priority for improvements should be focused on locations with increasing collisions. Options for improvement may include signalization, roundabouts, or channelization to restrict movements.

Chapter 7: Recommended Plan

This chapter summarizes the Transportation Plan recommendations to address deficiencies in the transportation system now and through the 2030 planning horizon, while recognizing the fiscal and scheduling complexities of implementing costly facility improvements. This chapter also presents the financing and concurrency elements of the Transportation Plan Update.

FUNCTIONAL CLASSIFICATION

The determination of the appropriate classification for each street in a city requires a process that examines the relative role each street plays as part of the entire system. Because it is not possible to directly measure the proportion of "mobility" and "access" each street segment provides, the process involves an evaluation of several important criteria that correlate strongly with those primary attributes of mobility and access. The following are five criteria used for determining street classification, and for re-classifying roadways in the City of North Bend:

- **Average Daily Traffic (ADT).** Generally speaking the higher the traffic volume, the higher the classification of the street. The demand for traffic mobility is more likely to outweigh the need for access to abutting land on streets with higher traffic volumes. Conversely, where volumes are lower the access function of the street will generally be more important than mobility for traffic. Volumes in themselves do not define or determine the classification, however the following were used as guidelines:

Functional Classification	Average Daily Traffic (ADT)
Principal Arterial	7,500 and Up
Minor Arterial	2,500 and Up
Collector	500 and Up
Local Access	Less than 500

- **Non-Motorized Use.** The ADT criterion described above provides an easily obtainable measure of the number of vehicles using a given street. While ADT is an important yardstick, another very significant feature of a city's streets is the accommodation of non-auto modes, including walking, bicycling, and transit use. The number of modes of travel using a street is telling of a street's importance in the city's network— the more modes using a street, the more users that street serves, and the more important that street is to the movement of people, goods, and services throughout the city.
- **Length of Street.** The street length is another important criterion to consider in a street's classification. The longer a street is, the more likely it is that the street will function at a higher classification. This is due to the fact that longer (continuous) streets allow travelers to move between distant attractions with a limited number of turns, stops, and other distractions that discourage them from using streets of lower classification. Longer streets generally supply a higher level of mobility as compared to other streets that are providing more access.

- **Spacing of Streets.** Street spacing is another criterion that relates to the provision of mobility and/or access. Streets of higher classification usually have larger traffic carrying capacity and fewer impediments to travel. Fewer facilities are needed to serve the traffic mobility demands of the community due to their efficiency in moving traffic. Generally, this means that there are fewer streets of higher classification so there will be greater distances between them. Therefore, the farther the distance of a street from a higher classification street, the more likely it is that the street will function at a similar classification. Streets of lower classification are needed to provide access to abutting land. In order to do this, they must be spaced more closely and there must be many more of them. It is considered most desirable to have a network of multiple lower classification streets feeding into progressively fewer higher classification streets.

Roadway Type	Typical Street Spacing
Principal Arterials	1.0 mile
Minor Arterials	0.3 to 0.7 mile
Collectors	0.25 to 0.5 mile
Local Access	0.1 mile

- **Street connectivity.** Streets that provide easy connections (or connectivity) to other roads of higher classification are likely to function at a similar classification. This can be attributed to the ease of movement perceived by travelers who desire to make that connection. For example, state highways are generally interconnected with one another, to provide a continuous network of high order roadways that can be used to travel into and through urban areas. Urban minor arterials provide a similar interconnected network at the citywide level. By contrast, collectors often connect local access streets with one or two higher level arterial streets, thus helping provide connectivity at the neighborhood scale rather than a citywide level. Local streets also provide a degree of connectivity as a necessary component of property access. However, the street lengths, traffic control, and/or street geometry are usually composed so that anyone but local travelers would consider the route inconvenient. Access to the immediate neighborhood is considered a local trip.

Based upon these guidelines, the roadways that have been re-classification are presented in Table 10 and shown in Figure 12.

TABLE 10: 2012 CHANGES TO CITY FUNCTIONAL CLASSIFICATION FROM 2003 PLAN

Roadway, termini	Revised Classification
North Bend Way, 436th Ave SE-468th Ave SE	Minor Arterial
NE 4th Street, Bendigo Blvd-Ballarat Ave	Minor Arterial to Collector
South Fork Avenue SW Extension, Bendigo Blvd-NW 8th St	Collector
Pickett Avenue NE, E North Bend Way-NE 6th St	Collector
SE 140th Street, SE North Bend Way-468th Ave SE	Collector
SE 140th Street, 428th Ave SE to-432nd Ave SE	Collector
SE 136th Street Extension, 412th Way SE-436th Avenue SE (possible future route)	Collector

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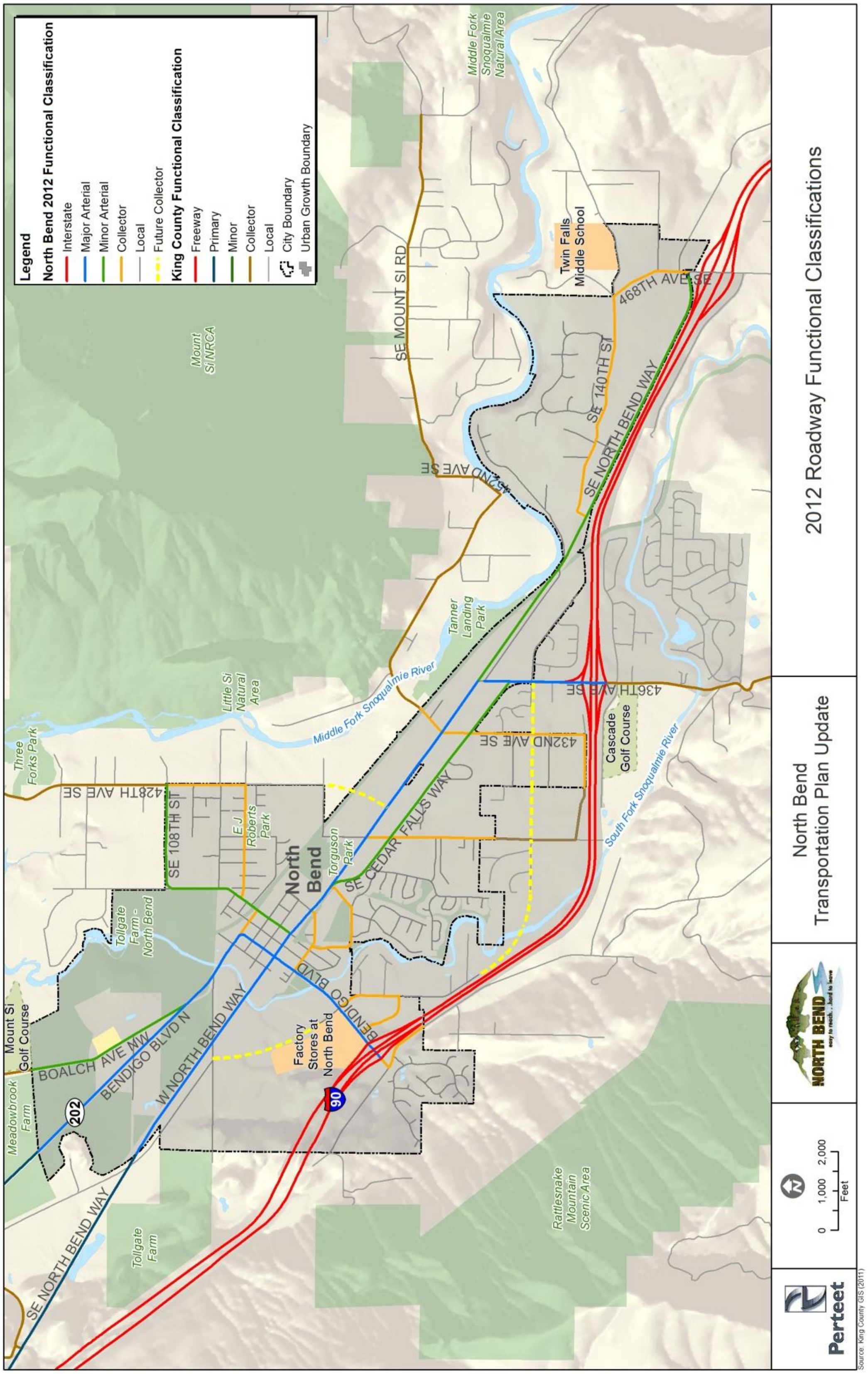
FIGURE 12: 2012 ROADWAY FUNCTIONAL CLASSIFICATIONS



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ROADWAY SYSTEM

Recommended Improvements

Project recommendations were identified for existing and projected 2030 traffic volumes based on planned land use growth. Suggested Capital Improvement Projects are shown in Figure 13, identifying vehicular and pedestrian projects, with locations keyed to the project descriptions.

Vehicular Project Recommendations

1. *South Fork Avenue Extension* – Extend South Fork Avenue from Bendigo Boulevard past the Nintendo site, a new 2-lane collector roadway connection to North Bend Way at 8th Street.
2. *Truck Stop Task Force* – Support the analysis of potential solutions to address the unique demands of heavy truck traffic circulation and parking in the Exit 34 vicinity, from I-90 to SE 140th Street, including all the intersections and major driveways.
3. *Bendigo Boulevard/4th Street Intersection* – Reconfigure the intersection to remove the diverter and allow full movements with implementation of a traffic signal or roundabout.
4. *North Bend Way/Park Intersection Improvement* – Design and construct a roundabout serving Park, Downing and the QFC driveway, with median treatments on North Bend Way.
5. *Downtown Plaza Improvement, Bendigo to Ballarat* – Construct streetscape improvements along North Bend Way with widened sidewalks, curb bulbs and plantings to create an attractive pedestrian environment and gathering place for special events.
6. *North Bend Way/Ballarat Traffic Signal* – (not needed if Plaza is implemented)
7. *Pickett Avenue Extension, NE 6th Street to North Bend Way* – Reserve right of way and extend a 2-lane roadway as a collector street to serve future residential development.
8. *Bendigo Boulevard/Park Intersection* – Construct an exclusive right turn lane for northbound traffic on Bendigo Boulevard to eastbound Park.
9. *SE 146th Street, 468th Avenue SE to east city limit* – Reconstruct the deteriorated 2-lane roadway with pavement suited to heavy vehicle loads.
10. *SE 146th Street at 468th Avenue SE* – Intersection control improvements; evaluate the need for installation of a traffic signal consistent with North Bend Gravel Operations FEIS.
11. *468th Avenue SE at Middle Fork Road* – Design and construct a roundabout as a truck turnaround with provisions for safe pedestrian and bicycle travel.
12. *SE 20th Street Extension* – Reserve right of way to extend a collector street from Maloney Grove to 436th Avenue SE to serve future residential development.
13. *North Bend Way at 436th Avenue SE* – Construct roundabout to serve growing traffic demand.
14. *North Bend Way at Mt. Si Road* - Construct roundabout to serve growing traffic demand from residential and recreational travel.
15. *South Fork Avenue Extension* **–** Reserve right of way to extend roadway as a collector street to serve future residential development from Mt. Si Boulevard to Maloney Grove Road.

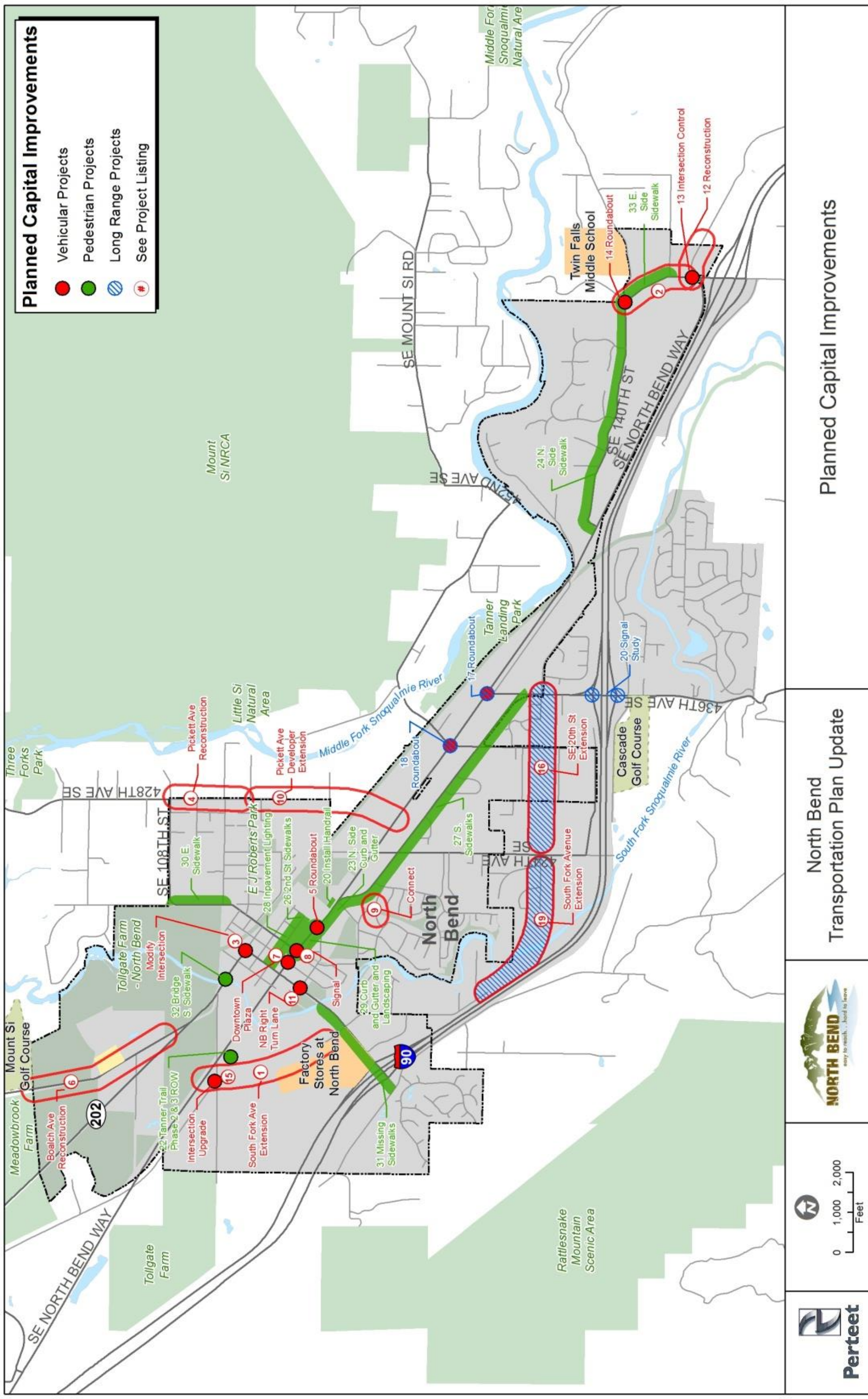
Pedestrian Project Recommendations

1. *Sidewalk Trip Hazard Elimination* – Non-specific locations to address ADA compliance issues as they occur due to cracking, heaving or other problems.
2. *Tanner Trail Right of Way Acquisition* – Acquire abandoned railroad rights of way for Phases 2 and 3, working west from Downtown parallel to the south side of W. North Bend Way.
3. *SE 140th Street, North Bend Way to 457th Avenue* – Construct sidewalk and or trail to connect to the Twin Falls sidewalk system west to the west end of the walk zone for student safety and improved pedestrian access to schools and pedestrian safety of the community as a whole, consistent with city standards.
4. *Old and New Si View Pedestrian Linkage* – Develop new trail connection off 10th Street.
5. *2nd Street Sidewalks* – Reconstruct existing substandard sidewalks in Downtown.
6. *SE Cedar Falls Way Sidewalks* – Construct a continuous sidewalk on south side from North Bend Way to 436th Avenue SE.
7. *North Bend Way, Ballarat to Downing* – Construct curb, gutter and landscaping both sides.
8. *Ballarat Avenue N, NE 8th to NE 12th Street* – Construct sidewalks on east side of roadway.
9. *Bendigo Boulevard, SW Ribary Way to South Fork Bridge* – Construct missing sidewalk sections, replace substandard sections, especially on west side of roadway and provide pedestrian-scale illumination.
10. *Bendigo Boulevard, South Fork Bridge Non-motorized crossing* – Construct standard width sidewalk pathway on south side of bridge for pedestrians and cyclists.
11. *468th Avenue SE, SE 144th Street to Middle Fork Road* – Construct continuous sidewalk on east side of roadway with pedestrian scale lighting.

Maintenance Project Recommendation

1. *Pavement Overlay Program* – Non-specific locations to perform pavement maintenance on annual basis at approximately $250,000 per year.

FIGURE 13: PLANNED CAPITAL IMPROVEMENTS


Planned Capital Improvements
Vehicular Projects
Pedestrian Projects
Long Range Projects
See Project Listing
North Bend
Transportation Plan Update
Planned Capital Improvements
Perteet
Source: King County GIS (2011)

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TRAFFIC CALMING PROGRAM

The City of North Bend has a traffic calming program administered by the Public Works Department and the Police Department. It is initiated by citizen complaints or comment and follows a three phase program toward identifying traffic problems and implementing in field solutions based on best available technology.

LAND USE AND URBAN PATTERNS

Central to the success of a public transportation system is the development of a compatible land use plan. One of the results of the use of the automobile has been land use patterns that can only be served by the automobile. Low-density suburbs and strip development are not designed to accommodate public transportation services. Changing the land use or traditional bus services is difficult and special attention must be given to increase the effectiveness of transit by controlling development and modifying the existing arterial street system and pedestrian facilities to bring passengers to the transit system.

Review of land use policies, development, and regulations should be made to ensure that changes can be accomplished to make the system work more efficiently. The city can influence the public transportation compatibility by considering the following development issues:

- Pedestrian access and facilities
- The amount, cost, and location of parking
- The location of high density residential developments
- The location and design of commercial and employment activities
- The location of transit facilities
- The location of community activity centers
- The design of building complexes and their surroundings

TRANSPORTATION DEMAND MANAGEMENT

Transportation demand management involves techniques and strategies to reduce traffic. The City of North Bend should apply the following methods to reduce traffic:

***Carpools and Vanpools*:** The City should promote programs to help commuters get together and share cars and/or vans. One approach is to work directly with employers to encourage employees to use alternative modes of transportation to get to work.

***Walkways and Bikeways*:** Street system should provide safe pedestrian walkways and bikeways. These facilities should be developed in accordance with City plan. Special emphasis should be given to pedestrian and bicycle improvements along and connecting to transit corridors and facilities.

POTENTIAL ENVIRONMENTAL IMPACTS

Environmental Impacts are evaluated on both a plan level (programmatic) and on a project-by-project basis through the State Environmental Policy Act (SEPA) for all Comprehensive Plan amendments. A SEPA checklist document was prepared for this programmatic (non-project)

Transportation Plan Update prior to adoption. Individual projects will be subject to separate environmental review as they are advanced for implementation.

CONCURRENCY MANAGEMENT SYSTEM

A Concurrency Management System (CMS) is a policy procedure designed to enable the City to determine whether adequate facilities are available to serve new development. The transportation element of the Growth Management Act (GMA) requires each local jurisdiction planning department to incorporate a Concurrency Management System into their comprehensive plan. A Concurrency Management System is defined in the GMA as follows:

> *Local jurisdictions must adopt and enforce ordinances that prohibit development approval if the development causes the LOS on a transportation facility to decline below the standard adopted in the transportation element of the comprehensive plan, unless transportation improvements or strategies to accommodate the impacts of development are made concurrent with the development. (State of Washington Growth Management Act, RCW 36.70A, 1990).*
>
> *Concurrent with development implies that public infrastructure improvements*[1] *that are required to service land development be in place, or financially planned, within six years of development use.*

The City of North Bend identifies the following concurrency management system guidelines:

- ***Identification of the Facilities and Services to be Monitored:*** Facilities to be monitored within the City of North Bend are the intersections of functionally classified streets (Major, Minor and Collector) and the streets between these intersections.
- ***Establishment of Level of Service Standards:*** The City of North Bend adopts Level of Service D as standard for Roads and Streets under the City's jurisdiction.

  The Growth Management Act stipulates that local agencies must include the adopted LOS for designated Highways of Statewide Significance (HSS) in their local plans. The Washington State Highway System Plan, 2007-2026 has set a goal to manage the State Highway System to achieve maximum throughput. Typically, the maximum throughput of a highway lane occurs at about 2,000 vehicles per lane per hour, at speeds of 42 to 51 miles per hour, or about 70-85 percent of the typical posted highway speed limit. WSDOT has targeted congested operating conditions for the investment of highway capital improvements where speeds fall below 42 miles per hour, or below 70 percent of posted speed. The objective is to restore efficient operating conditions to these "bottleneck" or "chokepoint" highway sections. Given limited available funding, the priority is to improve traffic flow for mainline through traffic and on/off ramps, and the Highway System Plan has identified an extensive list of congested corridor locations across the state for corrective action. The State's analysis does not include congestion associated with local roads, ramps,

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[1] The revised North Bend Concurrency Ordinance removed the "or strategies" from the original GMA wording of "improvements or strategies." The City's rationale for dropping "strategies" from the City's code was the perceived difficulty in defining and enforcing *strategies*, as well as ensuring that all parties satisfied.

interchanges, weather conditions, special events, construction, or collisions and incidents. There are no WSDOT highway facilities located within the North Bend planning area that have been identified for congested corridor-related investments by the State.

The Puget Sound Regional Council's Executive Board has adopted LOS standards for regionally significant state highways in the central Puget Sound region. Regionally significant state highways are state facilities that are not of statewide significance. Adoption of LOS standards for regionally significant state highways followed a year-long process involving WSDOT and the region's cities and counties.

The non-HSS LOS standard is a three-tiered arrangement designed to fit the needs of the Puget Sound region. Tier 1 (LOS E-mitigated) is applied to all of the designated urban centers as well as a three mile buffer around the most heavily traveled freeways (I-5, I-90, I-405, SR 167, and SR 520). Tier 2 (LOS D) is applied to the "outer" urban area outside the three mile buffer area and connecting the principal UGA to the smaller UGAs as applicable to Bendigo Boulevard (SR 202). Tier 3 (LOS C) is applied to rural highway routes that do not fit into the tier 2 category.

While state law exempts highways of statewide significance (HSS) routes from local concurrency regulation, GMA is silent regarding concurrency on regionally significant state highways. These regionally significant state highways must be addressed in local comprehensive plans by listing the LOS standards referenced above, but the law is silent in terms of including or exempting them from local concurrency rules. If the city desires to maintain a reasonable LOS on the non-HSS (SR 202) route, the city and developers should work with WSDOT to prevent the facility from falling below LOS D. Mitigation of impacts can be accomplished through operational or capital improvements. The City should therefore coordinate with WSDOT whenever development lowers or impacts a State facility that is operating at or below LOS D.

- ***Establishment of a Development Approval Process*:** The City of North Bend should maintain an adopted Concurrency Ordinance.

Concurrency Management System Implementation

Implementation of the Concurrency Management System involves the following steps:

- Set the level of service standards and provide adequate funding as recommended in the Transportation Plan.
- Ration and monitor available transportation capacity.
- Analyze external influences on the Concurrency Management System.
- Make periodic adjustments to the level of service standards as part of the annual *Comprehensive Plan* amendment process.
- Maintain a mitigation fee system to ensure new development pays its fair share to address its impacts on the transportation system.

FINANCIAL PLAN

As part of a municipal growth management program, the *Transportation Element* of the local comprehensive plan must ensure that adequate financial commitments are in place to complete necessary transportation improvements or strategies. The concurrency element of the GMA requires that transportation improvements are in place, or are funded and will be in place within six years.

The transportation finance element is organized using the following seven steps:

- Identify and inventory transportation needs.
- Develop cost estimates.
- Assess the ability to pay for the transportation projects and services.
- Develop financing policies.
- Establish a forecasted cash flow from the various financing resources.
- Develop a financing schedule to match transportation projects and services to cash flow.
- Establish policies to govern the management of the transportation financing program.

Recommended Improvement Costs

Preliminary costs were estimated at a planning level based on 2012 dollars. Estimates were prepared by the North Bend Public Works Department based on recent typical unit costs of actual construction. These planning level estimates of probable cost were the basis for the financial plan. The project costs include 20% for contingencies, 15% for design, 10% for construction administration, and 5% for permitting expenses. Table 12 summarizes the estimates for the recommended vehicular and pedestrian improvement projects identified in the previous section.

TABLE 12: RECOMMENDED PLAN IMPROVEMENT COSTS

Recommended Roadway and Pedestrian Projects	Construction Cost
Roadway System Improvements	Estimated $2012
1. South Fork Avenue Extension, Bendigo to North Bend Way/8th St	$2,250,000
2. Truck Stop Task Force	Not Applicable
3. Bendigo Boulevard/4th Street Intersection Reconfiguration	$85,000
4. North Bend Way/Park/Downing Roundabout & Median Treatments	$1,545,000
5. Downtown Plaza Improvement, Bendigo to Ballarat	$865,000
6. North Bend Way/Ballarat Traffic Signal (not needed with Plaza)	Not Applicable
7. Pickett Avenue Extension, NE 6th Street to North Bend Way	$2,450,000
8. Bendigo Boulevard/Park Intersection, NB to EB right turn lane	$149,350
9. SE 146th Street Reconstruction, 468th Ave SE to east city limit	$240,000
10. SE 146th Street at 468th Avenue SE Intersection Traffic Signal	$375,000
11. 468th Avenue SE at Middle Fork Road Roundabout	$1,150,000
12. NE 20th Street Extension, Maloney Grove to 436th Ave SE	$2,800,000
13. North Bend Way at 436th Avenue SE Roundabout	$1,150,000
14. North Bend Way at Mt. Si Road Roundabout	$1,150,000
15. South Fork Avenue Extension, Mt. Si Blvd to Maloney Grove	$7,400,000
Subtotal Roadway System Improvements	**$21,609,350**
Pedestrian System Improvements	
1. Sidewalk Trip Hazard Elimination (non-specific locations)	$78,409
2. Tanner Trail Right of Way Acquisition, Phases 2 and 3	$4,000,000
3. SE 140th Street, North Bend Way to 457th Avenue, N side sidewalk	$590,000
4. Old and New Si View Pedestrian Linkage off 10th Street	$6,500
5. 2nd Street Sidewalk Reconstruction, Downtown	$108,150
6. SE Cedar Falls Way Sidewalks, North Bend Way to 436th, S. side	$1,546,200
7. North Bend Way, Ballarat to Downing, curb, gutter & landscaping	$400,000
8. Ballarat Avenue N, NE 8th to NE 12th St, sidewalks on E side	$395,000
9. Bendigo Blvd, SW Ribary Way to S. Fork Bridge, missing sidewalks	$10,000
10. Bendigo Blvd, S Fork Bridge Non-Motorized Crossing Upgrade	$3,250,000
11. 468th Avenue SE, SE 144th St to Middle Fork Road sidewalk E side	$333,000
Subtotal Pedestrian System Improvements	**$10,717,259**
1. Pavement Overlay Program (non-specific locations, $250k/year x 19 years)	**$4,750,000**
GRAND TOTAL RECOMMENDED PLAN IMPROVEMENTS	**$37,076,609**

* Projects are not listed in any specific priority.

Revenue Sources

The City receives several sources of funds for street improvements, estimated to generate approximately **$920,000 per year on average**. These funds are described below:

- **Motor Vehicle Fuel Tax Arterial.** The City receives gas tax revenue annually in the amount of approximately $80,000. This amount is placed into the Arterial Streets Fund (102).
- **Business & Occupation Tax.** The City receives 80% of the B & O tax, implemented in 2003. The City estimates 80% generates $80,000 per year. This revenue stream is also placed in the Arterial Streets Fund (102) to help finance the 6-Year TIP.
- **Pavement Overlay Program.** Approximately $150,000 is currently set aside annually from the City's General Fund for pavement preservation, a routine maintenance activity. The eventual goal is to set aside $250,000 annually with annual adjustments for inflation thereafter.
- **Transportation Benefit District.** Annual estimated revenue of $387,000 will accrue from the two tenths of one percent (0.2%) increase in the local sales and use tax starting 2012.
- **Real Estate Excise Taxes.** The City has also a Capital Improvement (REET101), Special Revenue Fund with annual estimated revenue of $120,000. This fund accounts for the Real Estate Excise Taxes (REET) collected by the City. A REET is levied on all city-wide real estate transactions. State law restricts the use of these revenues: The first ¼ of one percent is restricted to capital projects; the second ¼ of one percent is restricted to capital projects identified in the Capital Facilities Plan.

Other revenue sources may include:

- **Grant Sources.** Potential sources of grant funds include the Washington State Transportation Investment Board (or TIB including several different grant categories), Washington State's Freight Mobility Strategic Investment Board (or FMSIB focused on truck and rail freight mobility), federal American Recovery and Reinvestment Act (or ARRA), King Conservation Futures, RCO, etc.
- **Property Ownership Contributions.** There are several ways that private property owners may contribute to the implementation of infrastructure projects including through transportation impact fees at the time of development, through the creation of Local Improvement Districts to finance projects with assessments against the benefitted properties, through the dedication of rights of way for planned facilities, or directly constructing the intersection improvements.
- **Other Funding Sources:** These may include bonds or the use of Public Works Trust Fund low interest loans.

Estimated Revenue Available to Transportation Projects

Table 13 presents an estimate of revenue available for transportation projects in the City of North Bend over a 19-year period. For each type of revenue, in other words, this is a rough estimate of what revenue might become available for roadway projects. The assumptions for this estimation are:

1) The City's sources of funding including fuel taxes, B&O, Transportation Benefit District, REET and Pavement Overlay Program will generate a total of **$12,458,000** over the 19 years through 2030. To maximize the leverage of these funds, the City needs to use them to match non-local grants, contributions from WSDOT, impact fees and/or development contributions.
2) WSDOT will fund improving the SR 202 South Fork Bridge to provide a barrier-free pedestrian crossing (**$3,250,000**).
3) The city will obtain approximately **$12,812,300** in grants from TIB, FMSIB, ARRA and other state and county sources in next 19 years, through 2030,
4) The city will collect **$1,900,000** in impact mitigation fees for roadway and pedestrian projects over the next 18 years, or $100,000 per year.

The resulting total estimated revenue available for transportation projects through 2030 is **$30,420,300**. This amount falls short of the total estimated project costs of the recommended plan by approximately $6.66 million, requiring some projects to be moved into the years beyond 2030, or for additional funding sources to be identified.

TABLE 13: ESTIMATED ANNUAL REVENUE FOR TRANSPORTATION PROJECT PERIOD, 2012-2030

Funding Source	2012-2017	2018-2023	2024-2030	Total
	(in 2012 Dollars)			
Transp. Benefit District	$2,400,000	$2,400,000	$2,800,000	$7,600,000
Real Estate Excise Tax	$0	$24,000	$84,000	$108,000
Business & Occupations Tax	$0	$0	$0	$0
Motor Vehicle Fuel Tax	$0	$0	$0	$0
Pavement Overlay Fund	$1,500,000	$1,500,000	$1,750,000	$4,750,000
Impact Mitigation Fees	$600,000	$600,000	$700,000	$1,900,000
WSDOT project funding	$0	$3,250,000	$0	$3,250,000
TIB, FMSIB, RCO, King Co & other Grants	$3,000,300	$3,312,000	$3,000,000	$9,312,300
Rural Set-aside, ARRA & other Federal Grants	$1,500,000	$500,000	$1,500,000	$3,000,000
Total (in 2012 Dollars)	**$9,000,300**	**$11,586,000**	**$9,834,000**	**$30,420,300**

ARRA = American Recovery and Revitalization Act
TIB = Transportation Improvement Board
FMSIB = Freight Mobility Strategic Investment Board (WA State)
Federal Funds = Rural set-aside
King Co = Conservation Futures (Tanner Trail Phases 2 and 3 acquisition)
Impact Mitigation Fees = Development related funds

Table 14 provides an outline of a project program to implement the recommended projects that address the existing and projected transportation needs of the City of North Bend and its planning area over the next two decades. The first period includes the 6-year transportation improvement projects, i.e. committed projects. The second period includes the recommended projects with relatively high priority. The last period includes the remainder of the recommended projects that will be needed to serve growth and development in the longer range. The total required project improvement budget is at about $37.08 million, which is approximately $6.66 million, or 18% greater than the projected available revenues shown in Table 13.

TABLE 14: 2012-2030 TRANSPORTATION IMPROVEMENT PLAN

Planned Project	Funding Period			Total Cost
	2012-2017	2018-2023	2024-2030	(2012 $)
Sidewalk Trip Hazard Elimination	$78,409			$78,409
Second Street Sidewalk Reconstruction	$108,150			$108,150
Bendigo/4th Street Intersection Reconfiguration	$85,000			$85,000
Bendigo/Park Street NB to EB right turn lane	$149,350			$149,350
Bendigo, Ribary to S. Fork Bridge, sidewalk sections west side	$10,000			$10,000
North Bend Way/Park/Downing Roundabout and Median	$1,545,000			$1,545,000
Downtown Plaza Improvement, Bendigo to Ballarat	$865,000			$865,000
South Fork Avenue Extension, Bendigo to North Bend Way/8th St	$1,850,000	$400,000		$2,250,000
Pavement Overlay Program (@$250,000/year)	$1,500,000	$1,500,000	$1,750,000	$4,750,000
Tanner Trail – Phase 2 and 3 ROW Acquisition	$4,000,000			$4,000,000
SE 146th Street Reconstruction, 468th Ave SE to E city limit		$240,000		$240,000
SE 146th Street/468th Avenue SE Intersection Control Improvement		$375,000		$375,000
SE 140th Street Sidewalk N side, North Bend Way to 457th Ave SE		$590,000		$590,000
Old and New Si View Pedestrian Linkage off 10th Street		$6,500		$6,500
468th Avenue SE at Middle Fork Road – Construct Roundabout		$1,150,000		$1,150,000
North Bend Way at 436th Avenue SE – Construct Roundabout		$1,150,000		$1,150,000
North Bend Way at Mt. Si Road – Construct Roundabout		$1,150,000		$1,150,000
North Bend Way, Ballarat to Downing, curb, gutter & landscape both sides		$400,000		$400,000

TABLE 14: 2012-2030 TRANSPORTATION IMPROVEMENT PLAN - *CONTINUED*

Planned Project	Funding Period			Total Cost
	2012-2017	2018-2023	2024-2030	(2012 $)
Bendigo Blvd Bridge over S. Fork @Tollgate Farm – widen south side sidewalk for peds & cyclists		$3,250,000		$3,250,000
Pickett Ave Extension, NE 6th St to North Bend Way – 2 lane collector roadway		$810,000	$1,640,000	$2,450,000
SE 20th St Extension, Maloney Grove to 436th Ave SE – 2 lane collector roadway			$2,800,000	$2,800,000
Cedar Falls Way, North Bend Way to 436th Ave SE – Sidewalk S side			$1,546,200	$1,546,200
Ballarat, NE 8th to NE 12th St, Sidewalk E side			$395,000	$395,000
468th Ave SE, SE 144th St to Middle Fork Rd – Sidewalk E side			$333,000	$333,000
South Fork Avenue Extension, Mt. Si Boulevard to Maloney Grove			$7,400,000	$7,400,000
Total	**$10,190,909**	**$ 11,021,500**	**$15,864,200**	**$37,076,609**

Contingency Plans in the Event of Revenue Shortfall

The revenue forecasts identified in the previous section are estimates that should not be considered highly reliable, especially when contributions by other units of government or property owners is identified. Many funding sources are difficult to predict with confidence, including grants, joint agency funding, and mitigation payments, which fluctuate with the pace of new development. However, these estimates provide a reasonable revenue forecast for planning and project programming purposes. The fact that Transportation Improvement Programs are reviewed, updated and adopted annually provides an ongoing opportunity to check progress and adjust course during the planning horizon. In the event that revenues from one or more of these sources is not forthcoming, the City has several options: lower the level of service standard; add new sources of revenue; increase the funding from existing sources; require developers to provide facilities at their own expense; and/or change the Land Use Element to reduce the amount of development.

CONCLUSION

The *Transportation Element* of the *Comprehensive Plan* serves to guide the development of surface transportation within the City of North Bend, based upon evaluation of existing conditions, estimation and evaluation of future conditions that result from the adopted future land use alternative, and the priorities stated by North Bend citizens. The *Recommended Plan* is a comprehensive financially balanced transportation plan that addresses current transportation issues as well as those that are expected to occur through the 2030 planning horizon.

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Appendices

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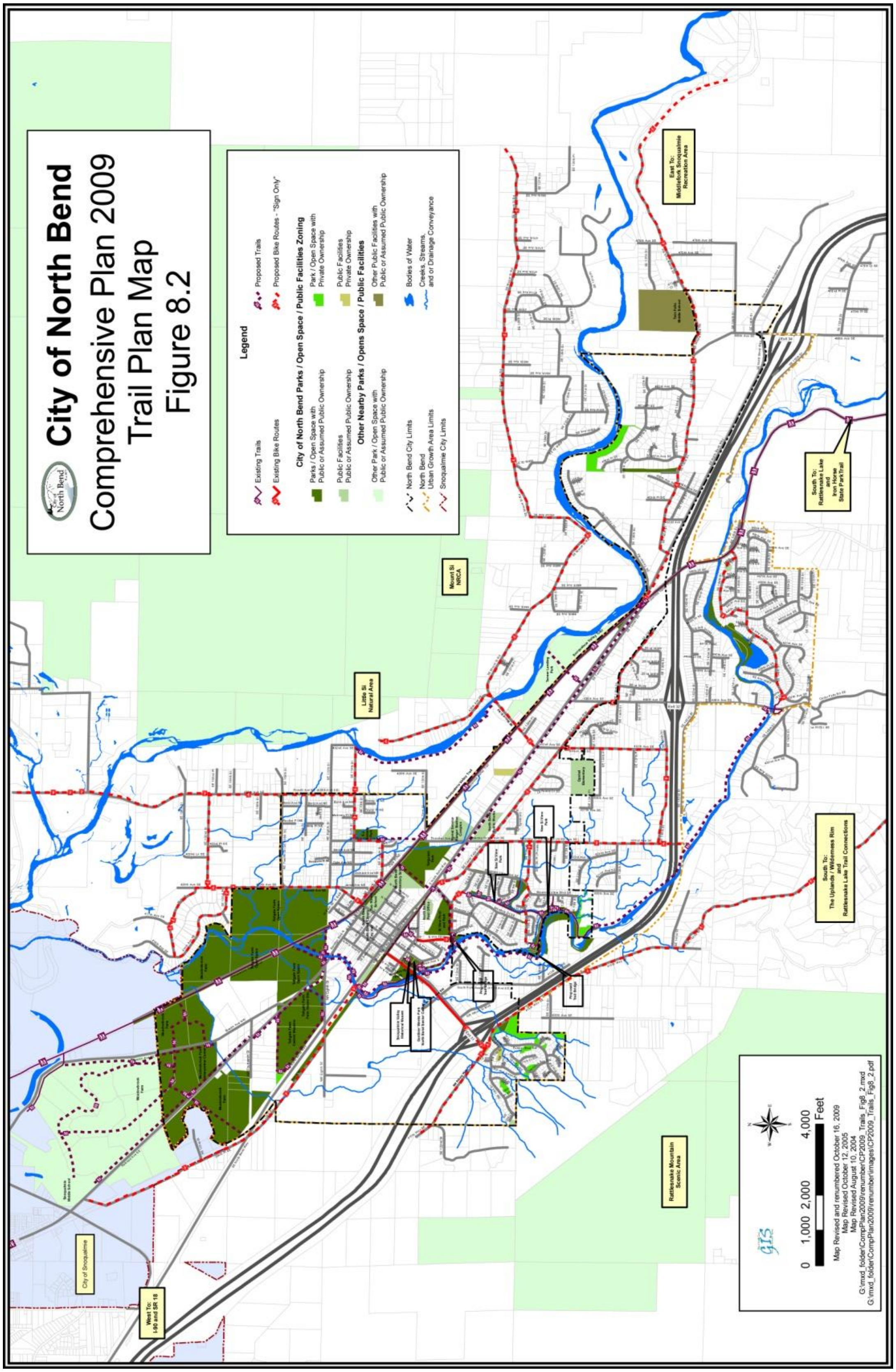
APPENDIX A: City of North Bend Comprehensive Plan 2009, Trail Plan Map



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APPENDIX B: Acronyms and Glossary

ACRONYMS

ADA	American with Disabilities Act
ADT	Average Daily Traffic
ARRA	American Reinvestment and Recovery Act
BRAC	Bridge Replacement Advisory Committee
CIP	Capital Improvement Program
CWPP	County-Wide Planning Process
GMA	Growth Management Act
HCM	Highway Capacity Manual
HES	Hazard Elimination Program
HOV	High Occupancy Vehicle
ISTEA	Intermodal Surface Transportation Efficiency Act
ITE	Institute of Transportation Engineers
LOS	Level of Service
MPO	Metropolitan Planning Organization
ROW	Right-of-Way
SOV	Single-Occupant Vehicle
TAZ	Traffic Analysis Zone
TDM	Travel Demand Management
TEA-21	Transportation Efficiency Act for the 21st Century
TIB	Transportation Improvement Board
TIP	Transportation Improvement Program
TSM	Transportation System Management
TRB	Transportation Research Board
VHT	Vehicle Hours of Travel
VMT	Vehicle Miles of Travel
WSDOT	Washington State Department of Transportation

GLOSSARY

Adopt
Method by which the City Council may vote to officially accept a policy, resolution or ordinance.

Amend
Method by which the City Council may officially alter or change a policy, resolution or ordinance.

American with Disabilities Act (ADA)
Federal civil rights legislation for disabled persons passed in 1990; requires the removal of barriers to mobility by disabled individuals in all public facilities, including public rights-of-way, and calls on public transit systems to make their services more fully accessible as well as to underwrite a parallel network of paratransit service.

Annexation
The act of incorporating an area into the domain of a city, county, or state.

Arterial, Minor
A street which serves as a distributor of traffic from a principal arterial to streets with less intensive use, such as collectors; serves secondary traffic generators such as neighborhood shopping areas and high schools, and serves traffic between neighborhoods. Less intensively used than principal arterials, minor arterials also may have little or no direct access to adjoining properties.

Arterial, Major
A street designed to provide the most efficient movement of traffic between a regional arterial, such as a highway, and major activity areas and points of destination such as shopping districts. Principal arterials also move traffic between communities, utilize traffic lights, and provide little or no direct access to adjoining properties.

Bond
Contract to pay a specified sum of money (the principal or face value) at a specified future date (maturity) plus interest paid at an agreed percentage of the principal.

Bond and Levy Financing
Local governments can raise revenues by selling tax-exempt municipal bonds or by increasing property taxes through property tax levies. Bonds require a 60 percent voter approval; levies require a simple majority. The City can issue a limited amount of debt without voter approval. Voter approval bonds are retired with property tax revenues.

Calibration
The process of adjusting the parameters of the mathematical travel models so that these models accurately simulate travel patterns observed in the base year.

Capacity
The maximum number of vehicles that can pass over a given section of a lane or roadway during a given time period under prevailing roadway and traffic conditions. The maximum rate of flow that has a reasonable expectation of occurring. In the absence of a time modifier, capacity is an hourly volume. Capacity would not normally be exceeded without changing one or more of the conditions that prevail. In expressing capacity, it is essential to state the prevailing roadway and traffic conditions under which the capacity is applicable.

Capital Improvement Program (CIP)
A plan for future capital expenditures which identifies each capital project, its anticipated starts and completion, and allocates existing funds and known revenue sources over a six-year period.

Census Tracts
A spatial unit of measurement used by the Federal Bureau of Census to collect demographic data.

CIP
See Capital Improvement Program.

Clean Air Act
The federal Clean Air Act identifies automobile sources (vehicles) as primary sources of pollution and calls for stringent new requirements in metropolitan areas and states where attainment of federal air quality standards is or could be a problem. A complementary law exists at the state level in Washington State, entitled the Clean Air Washington Act.

Collector
A street designed to move traffic from local streets and funnel it onto arterials. It may provide access to adjoining properties and is usually wider than local streets.

Commute
Describes travel or trip taken by those who work outside of their community.

Comprehensive Plan
Mandated by the Growth Management Act (GMA), it is a statutory document which sets forth long-range goals and policies concerning the desirable future and physical development of a community. The City of North Bend's plan is made up of five required elements including land use, housing, utilities, capital facilities and recreation and three supplemental elements including economic development, recreation and sensitive areas.

Concurrency
A GMA requirement that development and the extension of infrastructure occurs at the same time. The GMA requires that transportation facilities needed to maintain the adopted level of service standards for arterials and transit routes are available within six years of development. Concurrency is used to prevent sprawling development in areas that do not have infrastructure in place, and to ease the financial burden on the localities that build it.

Congestion
A condition which does not permit movement on a transportation facility at optimal legal speeds. Characterized by unstable traffic flows. Recurrent congestion is caused by excess volume capacity. Nonrecurring congestion is caused by actions such as special events and/or traffic accidents.

Consistency
A measure of whether any feature the Plan or a regulation is incompatible with any other related feature, plan or regulation. The GMA requires that the Plan be both internally and externally consistent.

Countywide Planning Process
As required by the GMA, the King County Council adopted a series of policies which embody a vision of the future of King County and guide the development of North Bend's Comprehensive Plan.

Density
The number of families, persons or dwelling units per unit of land usually expressed as "per acre" which describes the intensity of development.

Dwelling Unit
Describes a building or portion thereof providing complete housekeeping facilities for one family. The term "dwelling" shall not be deemed to include motel, tourist court, rooming house, or tourist home.

Expressway
A divided roadway with full or partial control of access. Interchanges are either grade-separated or controlled by traffic lights. Pedestrian traffic and access from abutting property are restricted. Expressways perform a similar function to freeways in carrying long-distance traffic between major traffic generators. However, rights of way are generally narrower and the degree of access control less strict than for freeways.

External Cordon Survey
A survey of traffic crossing an imaginary cordon line encircling the Study Area; designed to obtain trip data on persons traveling into, out of, or through the Area.

External Traffic Zone
A traffic zone located outside the boundaries of the Study Area. Trips crossing the Study Area boundary are allocated to the appropriate external traffic zone in which they originate or terminate.

Freeways
Freeways are divided roadways with complete access control. Their function is to carry large volumes of long-distance traffic between major centers of traffic generation. Interchanges are grade-separated, and pedestrian traffic and access from abutting properties are prohibited.

Forecasted Traffic Volume
The number of vehicles forecasted to travel on all or part of the street and highway network over a given period of time for a future year.

General Fund
The fund used to account for all financial resources except those required to be accounted for in another fund.

General Obligation Bonds
Bonds for the payment of which the full faith and credit of the issuing government are pledged.

Growth Management
Government programs that control timing, location and character of land use and development.

Growth Management Act (GMA)
State legislation passed in April 1990 which changed land-use planning in the State of Washington to provide for better growth management and transportation planning. The Act requires that local governments in fast growing and densely populated areas develop and adopt comprehensive plans. In 1991 the GMA was amended to further define requirements and to establish a framework for coordination among local governments through countywide and multi-county planning policies (RCW 36.70A).

High Occupancy Vehicle (HOV)
Vehicles having more than one occupant. Examples include carpools, vanpools, buses, and mini-buses. Transportation systems may encourage HOV use by having designated HOV lanes.

Impact Fees
Costs imposed on new development to fund public facility improvements required by new development and ease fiscal burdens on localities.

Intermodal Surface Transportation Efficiency Act (ISTEA)
ISTEA is a federal law, enacted in 1991, that reauthorizes federal statutes on planning and funding for roadways and transit projects. ISTEA made broad changes in the manner that transportation decisions are made. It emphasizes diversity and balance of modes and preservation of existing systems over construction of new facilities, especially roads. It adds a series of social, environmental, and energy factors that must be considered in addition to traditional considerations for transportation planning, programming, and project selection.

Jurisdiction
Includes counties and cities. As appropriate, the term "jurisdiction" also includes federal and state agencies and federally recognized tribes.

Level-of-Service
LOS is a descriptive measure of the quality of transportation service provided the user that incorporates finite measure of quantifiable characteristics such as travel time, travel cost, number of transfers, etc. Operating characteristics of levels of service for motor vehicles can be found in the latest edition of the Highway Capacity Manual, Transportation Research Board Special Report.

Local Street
A short-distance road primarily for access to abutting residential, industrial or commercial properties.

Major Road
A general term denoting any freeway, expressway, or distributor road.

Mitigation
The act of alleviating, abating, or lessening some problem or affliction.

Mode
The method of travel used, e.g. auto driver, vehicle passenger, public transport passenger, share a ride in a carpool or walking.

Model
A mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions.

Multimodal
Concerning or involving more than one transportation mode.

Network
A road, rail or other transportation system. A detailed link by link description of the routes covered by a transportation system.

Non-motorized
Generally referring to bicycle, pedestrian and other modes of transportation not involving a motor vehicle.

Park and Ride Lots
Park-and-ride lots refer to facilities which serve as a transfer terminal for automobiles and bikes and which are normally served by public transportation. They can include spaces used by persons transferring to carpools or vanpools whether officially designated for that purpose or not.

Right-of-Way
The land (usually a strip) acquired for or devoted to transportation purposes. For example, highway ROW and railroad ROW.

State Environmental Policy Act (SEPA)
The state law passed in 1971 requiring state and local agencies to consider environmental impacts in the decision-making process. A determination of environmental significance must be made for all non-exempt projects or actions which require a permit, license or decision from a government agency. Where significant adverse environmental impacts are not found, a Declaration of Non-Significance (DNS) is issued. Major adverse impacts require Environmental Impact Statement (EIS).

Single-Occupant Vehicle (SOV)
A vehicle having only one occupant (usually the vehicle operator!).

Transportation Demand Management (TDM)
TDM includes actions or programs which encourage people to travel at alternative times, or with fewer vehicles to reduce congestion. TDM reduces traffic volumes through methods including: ridesharing, park-and-ride operations, staggered work hours, and transit improvements.

Transportation System Management (TSM)
Actions or construction that control or improve the movement of cars and trucks on the highway system and buses on the transit system. TSM also includes the coordination of the available transportation systems for more efficient operation.

Traffic Assignment
The process of allocating trips onto existing or planned routes available on the highway or public transport network. Assignment may be based on one or more factors known to influence route selection, such as travel time, distance and/or cost.

Traffic Analysis Zone (TAZ)
The basic unit of area for traffic analysis. The region under study is broken up into traffic zones (about 100 in the case of North Bend). All trips to or from a zone are assumed to start or end at one selected point (zone centroid) within that zone. This process greatly reduces the number of possible origin and destination points to a magnitude that can be handled by a computer.

Traffic Calming
Traffic Calming refers to various design features and strategies intended to reduce vehicle traffic speeds and volumes on a particular roadway. Traffic Calming projects can range from minor modifications of an individual street to comprehensive redesign of a road network. Traffic Calming is becoming increasingly accepted by transportation professional organizations and urban planners.

Traffic Calming Devices
Physical features designed for a specific road and traffic condition. These may include bulb corners, chicane, landscaping, speed bumps, and passive speed control devices.

Traffic Counts
Number of vehicles observed as they pass by a manual count station or recorded as they cross an automatic counting device on a street or highway over a given time period.

Transportation Improvement Program (TIP)
The Transportation Improvement Program is a one- to three- year work plan which identifies projects from the Long Range Plan and the funding necessary to implement them. The TIP is usually revised annually. ISTEA requires that projects only appear in the TIP if funding is already secured for the work--it is not a wish list.

Travel Model
A system of mathematical relationships which can be used to estimate the volume and distribution of travel likely to occur in a given set of circumstances.

Trip Distribution
The geographical distribution of trips; the process by which the total number of trips is converted to individual zone to zone movements.

Trip Distribution Model
A mathematical relationship used to distribute trips between zones on the basis of certain parameters such as spatial separation and relative attractiveness.

Trip Generation
The number of trips produced by or attracted to a zone; the process by which the numbers of such trips are determined.

Trucks
2-axle vehicles with 6 wheels (single unit delivery-trucks), and vehicles with 3- or more axles, including multi-unit vehicles (typically called "semi-trailers" or "18-wheelers", and "double-bottoms" or "pup trailers and doubles", double trailers that may consist of three or four individual units totaling 7 or more axles).

Urban Growth Areas (UGAs)
Those areas designated by counties pursuant to RCW 36.70A.110 (State of Washington Growth Management Act) to accommodate 20-year growth projections. As generally defined in state law, such areas are those within which urban growth shall be encouraged and outside of which growth can occur only if it is not urban in nature.

Urbanized Area
An area defined by the U.S. Census Bureau according to the specific criteria designed to include the entire densely-settled area around each large city. An urbanized area must have a minimum population of 50,000 persons at a density of 1,000 persons per square mile.

Vehicle Mile of Travel (VMT)
On highways, a measurement of the total miles traveled by all vehicles in the area for a specified time period. It is calculated by the number of vehicles times the miles traveled in a given area or on a given highway during the time period. In transit, the number of vehicle miles operated on a given route or line or network during a specified time period.

Zoning
Classification of land in a community into different areas and districts. Zoning is a legislative process that regulates building dimensions, density, design, placement and use within each district.

Zoning Classification
A method of assigning a body of regulations to an area to ensure a type of growth that protects, preserves or enhances the area through the designation of allowed uses, building placement, and lot size.

Zoning Incentive
A planning technique granting additional development capacity in exchange for the developer's provision of a public benefit or amenity.

Zoning Ordinance
A set of land use regulations enacted by the City to create districts within which the type, location, density, bulk, height, and lot coverage of land uses are restricted.

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APPENDIX C: Six Year Transportation Improvement Program

Adopted 6-Year Transportation Improvement Program, 2012-2017

	Cost		Funding Sources					
Project Name	Design	Construction	Fed	State	County	Local	Total	Year
Tanner Trail, Phase 2 and 3 R/W Acquisition	$4,003,120	$0	$9,046	$1,997,037	$1,997,037	$0	$4,003,120	09-14
North Bend Way Handrail Installation	$2,000	$18,000	$0	$0	$0	$20,000	$20,000	12
Pickett Ave Reconstruction (6th to 12th)	$78,646	$611,454	$0	$0	$0	$690,100	$690,100	12-14
Downtown Crosswalk Impr. with in-pavement lighting	$5,000	$120,510	$0	$0	$0	$125,510	$125,510	12-13
Sidewalk Trip Hazard Elimination	$9,409	$69,000	$0	$0	$0	$78,409	$78,409	12-13
North Bend Way/Ballarat Signal	$46,350	$360,500	$206,000	$0	$0	$200,850	$406,850	13-14
Bendigo Traffic Reconfiguration (3rd to NBW)	$10,825	$79,403	$0	$0	$0	$90,228	$90,228	14
North Bend Way/Park Intersection Improvement	$148,320	$1,396,680	$360,500	$515,000	$0	$669,500	$1,545,000	13-15
North Bend Way C&G/landscape (Ballarat to Orchard)	$32,188	$235,932	$0	$0	$0	$268,119	$268,119	13-15
North Bend Way/NW 8th St Intersection Improvements	$148,320	$1,087,680	$0	$0	$0	$1,236,000	$1,236,000	16
2nd Street Sidewalk Reconstruction	$12,978	$95,172	$0	$0	$0	$108,150	$108,150	12
Right Turn Lane, N Bound Bendigo at Park St	$25,750	$123,600	$0	$0	$0	$149,350	$149,350	13-14
Boalch Avenue Reconstruction	$75,087	$550,638	$0	$0	$0	$625,725	$625,725	13
Pavement Overlay Program	$150,000	$1,650,000	$0	$0	$0	$1,800,000	$1,800,000	12-17
Totals	**$4,747,993**	**$6,398,569**	**$575,546**	**$2,512,037**	**$1,997,037**	**$6,061,941**	**$11,146,561**	

Notes:

Pickett Ave Reconstruction to be funded by REET

Federal contributions to NBW/Park Intersection are from Rural Setaside

Federal contributions to Ballarat signal project are from Rural Setaside

State contributions to Tanner Trail are from RCO

County contributions to Tanner Trail are from Conservation Futures

Additional projects may be added pending update to Transportation Comp Plan

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Appendix D: Traffic Forecasting Model Report

Provided by Eco Resource Management Systems, Robert Shull – Transportation Modeling

The traffic forecasting model for North Bend, WA uses PTV Vision VISUM version 11.52+, by PTV AG, Karlsruhe, Germany with local support from PTV America, Inc., Portland, Oregon. The previous model was imported from the previous TMODEL2 software (© TModel Corporation, Vashon, WA). PTV Vision VISUM is in use worldwide, and is used by a large number of Washington cities and MPOs. A major virtue of PTV Vision VISUM and previously TMODEL2 is its advanced capability for simulation of intersection delays based on type of traffic control and lane geometry. This is an important consideration when modeling a local area traffic network for peak hour conditions. TMODEL Corporation had merged with PTV America, Inc. in 2004 and important features of TMODEL2 were incorporated into PTV Vision VISUM at that time.

Summary Description of Traffic Model

The traffic model for North Bend, WA simulates afternoon peak hour volumes. The model was updated and calibrated to accurately "predict" known traffic counts for the base year 2011. Forecasts of future year traffic volumes can be developed with this model by entering new data for assumed future road conditions and land use growth.

Land use and road data is coded for 99 internal Traffic Analysis Zones and 9 external zones, 1056 directional links, 499 nodes, and 286 centroid connectors.

The North Bend area is quite self-contained, being situated in the Snoqualmie River valley and surrounded by the Cascade Mountains. The Traffic Model represents the City of North Bend, WA in great detail, and a necessary amount of surrounding areas. The Traffic Model accounts for travel connections beyond this area by means of external zones representing the highway connections via Interstate 90 east and west, State Route 202 to Snoqualmie, and certain other local roads extending into forest areas.

ACCURACY OF TRAFFIC MODEL FOR NORTH BEND, WA

As further detailed in a later section, the model reproduces existing traffic counts with an R-Squared correlation statistic of 0.89, Root Mean Squared Error (RMSE) statistic of 28% and 92% percent of counts within limits specified in NCHRP 255. The standards are R-Squared should be 0.88 or above, RMSE should be 35% or below, and 75% of links classified as Principal Arterial and above should be within NCHRP 255 limits. The updated North Bend area model meets and exceeds all of these standard measures.

HOW TRAFFIC FORECASTING MODELS WORK (KEY PRINCIPLES)

This section provides a general introduction to traffic models, to set the stage for later sections which provide specific details about the traffic model developed for North Bend, WA.

Traffic forecasting models, such as VISUM, simulate traffic flows on roadways using *mathematical models of human behavior*, combined with *inventory data* about the particular study area at hand and its human population:

(a) the physical description of the road network in terms of speed and capacity on each represented road section or link, and the traffic control and channelization characteristics of each intersection;
(b) the amount of land use of various types that exists within in each of many small geographic areas, called Traffic Analysis Zones (TAZs);
(c) the facilities and services available for alternative modes such as transit and ridesharing.

Human travel behavior characteristics are represented by
(a) trip generation rates for each class of land use;
(b) mode choice factors for the study area population;
(c) mathematical procedures to distribute trips between all TAZs, and
(d) mathematical procedures for the routing of trips through the road network (called Traffic Assignment).

Road Network Inventory Data.
At the basic level, each road included in the network is described by its length, free-flow operating speed, and capacity. Many regional-scale traffic models disregard intersection effects entirely. VISUM is ideal for local-area modeling because it adds a rather sophisticated simulation of intersection delay as well, based on the lane configuration and type of control used at each intersection or interchange. As a result, VISUM can model the change in travel demand that results from a local transportation system change as small as adding a traffic signal to an intersection, or adding turn pockets, or favoring or penalizing any given approach.

Land Use Inventory Data.
Traffic models require land use data in more precise local detail than most secondary sources have assembled it. This makes local land use monitoring an important consideration. Regional planning agencies rely on federal census data for population and housing, and state-collected employment information about employers. Such data is usually one to three years old before it is released in final form, and the aggregation level in terms of census tracts or postal zip codes may be too gross for local-area modeling purposes. Converting data from those sources requires additional effort to be accurate at the local level, and a further effort to account for changes to the present year based on development review and building permit activity. For these reasons, many local-area traffic models use instead locally maintained land-use data such as is available from the local North Bend, WA's planning Geographic Information System (GIS), or from the county assessor's inventory of land parcels and structures built on each parcel.

Alternative Modes Data.
To the extent necessary for the local area, traffic models may include options to split calculated trip generation by persons among competing choices of travel modes, such as transit, carpools, vanpools, bicycling, and walking. The form and level of detail for this varies considerably from place to place. Truck and taxi travel may also be explicitly modeled where needed. For this update of the North Bend model, the same procedures were used as previously applied, which means alternative modes were not explicitly modeled. However, it must be understood, that the trip generation rates used and validated for the model (as shown with the statistical analysis) implicitly model the effect of alternative modes.

Human Behavior Factors.
The framework of human behaviors affecting travel decisions was identified in research from the 1950s and 1960s, as documented in technical literature, however, the numeric parameters vary over time and from place to place because people's choices are not universally constant. The traffic model for North Bend, WA is calibrated for local conditions in the following steps:

(a) *Trip generation* is largely determined by the type of land use. Trip generation factors in a traffic model are similar in the aggregate to the driveway total trip rates reported by the Institute of Traffic Engineers for a wide range of land uses. However, I.T.E. trip generation rates only describe total vehicle trip generation at a site, without further detail about the reasons for travel, nor does I.T.E. count trips by other modes. Traffic forecasting models account for trip generation in terms of several *trip purposes* (home-based *work-commute* trips, home-based *non-work* trips, *non-home-based* trips, *school* trips, *truck* and *taxi* trips, and other special-case purposes). Each trip purpose has distinct characteristics for later steps of the modeling process, pertaining to *trip length*, *time-of-day patterns*, *mode choice* and *vehicle occupancy*. Trip generation rates may be established for 24-hour daily travel, for morning or afternoon peak hours, or peak periods, depending on needs and interests for planning and design.

(b) *Trip distribution* is the modeling step that allocates the trips generated in each zone to all other zones. The pattern of *trip length frequencies* differs significantly for each *trip purpose*. For example, people are willing to travel much longer distances to commute to/from work, than for most other trip purposes. The computational procedure is called the gravity model, since it follows the mathematical form of Newton's Law of Gravity: the amount of human activity (trip generation) in each TAZ proportionately increases the likelihood of trips occurring between any two TAZs, but that likelihood diminishes with increasing *travel time* between the TAZs. Travel time through the road network is affected by road conditions of speed, capacity, and congestion. Since availability of direct connections also matters in the choices humans make between alternative trip destinations, the VISUM procedure allows use of a weighted average of travel time and travel distance between zones, each for trip distribution and trip assignment. As recommended in current research, the North Bend model now uses an iterative feedback loop with weighted averaging to reach equilibrium convergence between the travel times used for distribution and those computed from trip assignment. The end result of the trip distribution step is a *trip table*, which gives the number of trips traveling between each zone (TAZ) and each other zone. A trip table may be calculated for a 24-hour day, or a morning or afternoon peak hour, or peak periods, according to how the trip generation rates are established.

(c) The *trip assignment* step allocates trips to specific paths through the road network, after the distribution process has determined how many trips travel between any given zone and all other zones. Assignment is now performed with an equilibrium assignment methodology, including updates of the delay that occurs on each road link and each intersection, based on the amount of traffic assigned. The total travel demand between any two TAZs may end up being allocated to two or more alternative routes. The assignment process does not rigidly prevent a link from receiving more traffic demand than its given capacity. The trip assignment process may shift some demand from a congested route to other available parallel paths that are less congested, but if there are no better options, the demand will remain allocated to the same route even if capacity is exceeded. However, the forecast delay for an overloaded link or node will be extremely high. A forecasted overload thus signifies an unsolved problem with unmet demand for additional capacity, and a need for further analysis of alternative solutions.

Time Periods. The entire modeling process may be carried out for 24-hour total *daily* trips, or for shorter intervals such as the peak *hour* of morning or afternoon commuting, or for a peak *period* of two or three hours. Daily modeling is popular for statewide or regional planning purposes where the issues are more general, but is seldom used in local area planning because the concept of "daily capacity" is very inexact. Local area modeling usually focuses on peak hour conditions when the capacity constraints are most critical and best related to design requirements for improvements.

Mode Choice. The process described above is typical of suburban area traffic models, where almost all travel demand is served by the automobile mode. A fourth modeling step, to allocate a share of total trips to transit and other non-automobile modes, is used in large *multi-modal* regional planning models. The North Bend model uses trip rates that implicitly include mode choice, but only generate automobile trips for distribution and assignment. Mode choice elements can be added to a local-area traffic model, at a level of detail suited to the issues at hand.

Calibration and Validation. The *calibration* of a new traffic model consists of assembling the model data for existing conditions of the land use and road system, setting the trip generation rates and trip length frequency parameters, and setting other detailed formula assumptions within the model, to best represent local current conditions. Validation consists of comparing the resulting traffic assignment to actual traffic counts, and possibly other available survey data, to show the degree of correlation between the base-year model and base-year survey information. A well-calibrated model will provide a close correlation to existing counts, when it is populated with existing land use and road information. Calibration errors should be minimal and evenly distributed, to consider a model "validated" and therefore suitable for use in planning and design studies.

Data Integrity. Calibration problems may arise from the formulation of human behavior patterns represented by various formulae in the model, or they may arise from inaccurate input data regarding land uses and the road system. Therefore all assumptions must be checked carefully to resolve the issues. The input land use data may come from several sources which need to be reconciled, and they may require adjustments to fit the model's TAZ framework and calendar year. Failure to account specifically for recently occupied developments is a common cause of "error" when a traffic model's volumes are compared to recent traffic counts. Traffic counts assembled from other sources will usually include inconsistencies between nearby locations, for various reasons. The goal is to represent conditions actually existing at a specific point in time consistent with the land use information. Most available traffic count data is collected for just one or two days at each location, and counts throughout the study area may be collected in different months, seasons, or even years of time. This adds considerable room for random variations, and makes it difficult to precisely match all counts to the single point in time represented by the land use data. The level of detail in the model also affects the level of accuracy to be expected from the model. The number and size of TAZs affects the accuracy of modeled volumes on road links near the connecting points where traffic moves between the TAZ and the road system. For greater local accuracy, more links and intersections must be coded, and TAZs must be smaller and more precisely defined. Regional-scale traffic models have very large TAZs and thus are usually unable to forecast traffic demand on the local road network beneath the level of freeways and major highways.

Post-processing. A well-calibrated model will inevitably still show some residual differences between the modeled base-year traffic volumes and actual base-year traffic counts. In any future-year application, these residual differences should be at least acknowledged. They may also be offset by *post-processing* adjustments, sometimes called *calibration adjustment*. For example, if the model under-predicts existing counts by 100 trips, it is likely to under-predict future conditions in the same or a similar way. A reasonable post-processing adjustment would be to add 100 trips to the modeled future volumes, *all else being equal*. Post-processing adjustments are, however, also subject to interpretation since future conditions will differ in some ways from existing conditions, which corrupts the assumption about *all else being equal*. There may or may not be a solid justification to apply the same *calibration adjustment* as in the base year. This is a difficult area of subjective interpretation, and it is frequently left undone as a result.

Post-processing is most justified in the case of short-term future forecasts where the road system and land use changes are not large, *and especially if comparisons to known traffic counts are an important part of the analysis*. Post-processing is least necessary for long-range future alternatives analysis where many changes in assumptions are involved and *the comparisons are mainly between alternative scenarios and decision choices* rather than against existing counts. The need to consider post-processing is generally eliminated if the model is used to identify net changes or differences between any two model runs, rather than to forecast absolute traffic volumes. For use in intersection LOS analyses, the approach of adding and subtracting the calibration deviations was used to adjust for the model differences.

How Traffic Forecasting Models Are Used in Planning and Design

Traffic models are more properly described as *travel demand forecasting models*, since the main output is the volume of travel demand on roads, by individual links and turning movements at intersections. Secondary outputs of traffic models include travel speeds and measures of delay including congestion effects. Traffic models can also identify the particular zone-to-zone travel patterns that use a given road link, or identify the road links which are used by trips to/from any given TAZ, or for a particular trip purpose. When the forecast travel demand is within the limits of capacity on all road links, the tested scenario is viable. A forecast that shows travel demand exceeding capacity, whether in one location or spread throughout an area, indicates a lack of balance between the capacity of the assumed transportation system and the land use assumptions which generated the excess travel demand. The tested scenario's land use and transportation assumptions are not in balance until overloads are corrected by changing the input assumptions. Resolving such issues represents the "art" of transportation planning, in contrast to the "science" of the traffic model.

There are several ways to interpret a modeled forecast of capacity deficiencies:

(a) There may be a straightforward solution in the form of capacity improvements to the overloaded road facilities;
(b) The overload may be due to excess demand elsewhere which the assignment model diverted to parallel routes such as the subject location;

(c) There may be viable alternative assumptions to shift excess demand to other modes, to other times of day, etc., or to accept higher congestion (e.g., reduce level of service standards) which in turn lead to altered understanding of the meaning of "capacity". If the capacity improvements necessary for balance with travel demand cannot be justified based on any combination of factors including design features, right-of-way availability, construction cost, timing, social impacts, economic impacts, environmental impacts, implementation feasibility and/or political support, then a solution may only be possible if the assumed land uses are changed. Since the traffic model fundamentally forecasts future travel demand based on assumed land uses, it can be fairly described as a *land use impact model*.

Standard Procedures of the Traffic Model for North Bend, WA

IMPORTANT: *The user is assumed to possess and understand the VISUM Manual, and be familiar with traffic modeling in general and have prior training in VISUM practices. This document only accounts for the specifics of this model for North Bend, WA in that context.*

This traffic model uses land use data to simulate traffic volumes on the present and future streets in North Bend, WA and immediately adjacent areas. All important roads in those areas are addressed in full detail, and the model also covers surrounding areas at a lesser level of detail. Modeling procedures account for several different trip purposes, provide for transit and park/ride modes, and for trip chaining behavior.

Time Period. The traffic model for North Bend, WA simulates afternoon peak hour volumes.

Base Year Model. The updated base year model represents the inventory of actual land use and road conditions for the year **2011**. This model was calibrated to accurately "predict" known traffic counts for the base year, as further described in the section on Model Validation.

Size of Model. The updated 2011 base year model consists of 99 internal TAZs and 9 external stations, 1056 directional links, 499 nodes, and 286 centroid connectors.

Future Year Forecasts. Alternative versions of the model can be set up to represent alternative assumptions about future land use growth, future road improvements, and future mode choice.

GEOGRAPHIC SCOPE AND ZONE SYSTEM

The Traffic Model represents the City of North Bend, WA in great detail, and surrounding areas as needed to account for the occupied residential land area of the Upper Snoqualmie Valley and tributaries. The adjacent City of Snoqualmie is not included in the model, to simplify data management. Snoqualmie traffic is included in the external zone representing SR 202 at the northwest edge of the model area.

The area represented at full detail includes North Bend, WA and some surrounding areas of high interest. All arterials and collectors are included, as well as many local access roads, and the size of individual zones (TAZs) is small. In more distant areas, there is progressively less detail, with fewer collectors and minor arterials (if any), and the zones are larger (See Figure 13 for reference). At the outer limits of the study region only freeways and selected other principal arterials area included, and the zones are very large. With this style of geographic continuity, the trips to/from/within North Bend, WA are seamlessly integrated with regional travel patterns involving adjacent areas. Travel through North Bend, WA from outside areas is explicitly modeled as trips between remote zones, as an automatic product of the distribution model.

EXTERNAL LINKS

Travel to/from the region outside the City of North Bend is accounted for by nine external zones, serving the areas described as follows:

External zones 100 and 101 represent the interstate corridor, and have predominantly through travel. Zone 100 to/from the Seattle-King County metro area is the major source of work-commute trips to homes in North Bend, and the major source of shopper trips to/from the Factory Outlet Mall. The distance from North Bend to the major population centers of the region is from 15 to 30 miles via this route. Zone 101 represents the recreation area of Snoqualmie Pass and beyond to Eastern Washington and all states east to Boston, MA.

External zone 102 accounts for trips to/from I-90 west via North Bend Way. Travel on this road is essentially a sub-set of the external-internal flow between I-90 West and the City of North Bend. There is also a connection from North Bend Way into the City of Snoqualmie via Meadowbrook Way, just beyond the limits of this model. Meadowbrook Way is predominantly used as access to/from I-90 for the City of Snoqualmie, and traffic counts indicated very little travel between the City of North Bend and Meadowbrook Way. Therefore, the model limits were placed close to the west city limits of North Bend and Meadowbrook Way was not included in the model.

External zone 103 represents the intercity travel between North Bend and Snoqualmie, and a minor amount of other longer-distance travel through Snoqualmie to the region beyond.

External zone 104 (Balch Road) is a low-volume connection to Snoqualmie's eastern residential fringe area, farming areas, and the Mount Si Golf Course.

External zones 105-108 represent primitive forest roads leading to major recreational areas, as follows:
105 – 428th Ave SE (to/from primitive forest recreational area north of city)
106 – Mt. Si Road (to/from primitive forest recreational area north of city)
107 – Middle Fork Road (to/from primitive forest recreational area east of city)
108 – Cedar Falls Road (to/from primitive forest recreational area south of city)

These zones were assigned small non-zero trip values for purposes of the traffic model, but there are no counts to validate those estimates. The primary use of these zones is recreational. They do not account for any significant amount of weekday afternoon peak hour traffic on an annual average basis, and could have been omitted. (Peak summer days may be an exception, but no traffic data exists for that extreme situation.) Existing rural residential uses along these respective forest roads were accounted for by internal zones. These external zones would be most useful as generators of recreational traffic that should be considered if a daily travel model or weekend activity model were to be created. During the calibration process, the estimated numbers of external trips for all external zones were updated to reflect updated count data.

ROAD NETWORK
The road network description accounts for all functionally classified roads and many local roads in North Bend, WA and vicinity, consistent with its very finely detailed TAZ structure. To facilitate coding and checking a geographically correct background map was added to the Point-Of-Interest (POI) layer of the model when it was imported from TMODEL2 to PTV Vision VISUM software.

LINK INVENTORY DATA CODING
The major road link inventory attributes in the updated model are Type, lanes, 1-or-2-way operation, free-flow speed, and link length. From these data elements, directional hourly capacity is automatically determined from Link Type lookup table which is now incorporated directly in the model procedures. The 2011 traffic counts are now also included directly in the network file for model validation comparisons and later post-processing adjustments.

Automatic Link Coding. To assure that automatic recalculation is always effective and consistent; no links should be coded with "arbitrary" speed or capacity, to achieve better modeling performance. Such problems should be solved instead by improving the model accuracy in other areas. Capacities are automatically computed when the model is run, so any manual adjustments or accidental revisions to capacity are corrected automatically at that time. This is an important consideration in establishing the unbiased credibility of the traffic model. For calibration improvements, attention should be focused instead on other areas of the model if the link is properly characterized in the Type, Number of Lanes, and free flow speed (v0) fields.

Link Type Field. The classification scheme for actual or planned roads includes local streets, collectors, arterials, freeways, ramps, and exclusive Bus/HOV lanes. In addition, there are classification codes to represent zone centroid connectors, and other types of artificial links. Link Type codes are used in several VISUM procedures, to specify the link speed and capacity in a mass network update, to calculate delays in the distribution/assignment process, and can be used in other procedures to determine Level of Service, calculate emissions, etc.

GIS Exchange Codes. This option was not used but was discussed in the previous implementation of the North Bend WA Traffic Model. PTV Vision VISUM now allows direct importing and exporting of GIS shapefiles as well as transfer of data with databases, excel, and the windows clipboard. There is not a need for GIS exchange codes for the future. For possible use of the model for comparisons with older versions, the TMODEL Class, Area, and Type values were imported for each link and these values are retained with the updated model.

Link 1 or 2 Way Field. The previous model was coded for 1 or 2 way traffic. In this update using VISUM, directionality is controlled by allowing or not allowing a Transport System (abbreviated as TSys) to use a link. Freeways and Ramps are coded as one-way links for better control and visual representation. The need for turn prohibition codes is reduced somewhat by the use of one-way links.

On rare occasions a two-way arterial street does not have the same attributes in both directions (number of lanes; uphill vs. downhill speed), this difference in attributes can be coded directionally. Unlike TMODEL2, two one-way links may not be used between the same pair of nodes. Caution is advised because this abnormal coding is hard to see on the network screen and could lead to confusion and other coding errors.

Link Lanes. The field value is the number of moving lanes in one direction. The normal assumption is that each direction has the same number of lanes. If not, this can be coded directionally. The effect of auxiliary lanes is generally not treated in this field. Examples include median left turn lanes, short passing lanes, and turn pockets approaching intersections. Those road features are accounted for by the distinct Type field, since they serve to increase the through capacity of the true through lanes rather than contribute the capacity expected from a normal through lane. They may also be accounted for in the value of Node Capacity and were explicitly coded in node geometry for LOS analysis locations.

Link Capacity. This value is automatically generated from the number of lanes, and the capacity/lane specified in the Link Types table within the model .ver file. The steps to compute the capacities are built in to the model run. Table D-1 shows the link Types and Capacities per lane used in the model.

Table D-1: Link Types with Capacity and Speed

Type	NAME	Capacity/Lane	Speed
11	Local Access Street-Speed 10	200	10
12	Local Access Street-Speed 15	200	15
13	Local Access Street-Speed 20	400	20
14	Local Access Street-Speed 25	500	25
15	Local Access Street-Speed 30	500	30
16	Local Access Street-Speed 35	800	35
21	Collector Arterial-Speed 15	500	15
22	Collector Arterial-Speed 20	500	20
23	Collector Arterial-Speed 25	500	25
24	Collector Arterial-Speed 30	500	30
25	Collector Arterial-Speed 35	800	35
26	Collector Arterial-Speed 40	800	40
31	Minor Arterial-Speed 20	500	20
32	Minor Arterial-Speed 25	500	25
33	Minor Arterial-Speed 30	800	30
34	Minor Arterial-Speed 35	800	35
35	Minor Arterial-Speed 40	800	40
36	Minor Arterial-Speed 45	800	45
41	Principal Arterial-Speed 25	800	25
42	Principal Arterial-Speed 30	800	30
43	Principal Arterial-Speed 35	800	35
44	Principal Arterial-Speed 40	800	40
45	Principal Arterial-Speed 45	800	45
46	Principal Arterial-Speed 50	800	50
51	Highway-Speed 30	900	30

Table D-1: Link Types with Capacity and Speed - *continued*

Type	NAME	Capacity/Lane	Speed
52	Highway-Speed 35	900	35
53	Highway-Speed 40	900	40
54	Highway-Speed 45	900	45
55	Highway-Speed 50	900	50
56	Highway-Speed 55	900	55
71	On/Off Ramp-Speed 25	1000	25
72	On/Off Ramp-Speed 30	1000	30
73	On/Off Ramp-Speed 35	1000	35
74	On/Off Ramp-Speed 40	1000	40
75	On/Off Ramp-Speed 45	1000	45
76	On/Off Ramp-Speed 50	1000	50
81	Freeway-Speed 50	2000	50
82	Freeway-Speed 55	2000	55
83	Freeway-Speed 60	2000	60
84	Freeway-Speed 65	2000	65
85	Freeway-Speed 70	2000	70
86	Freeway-Speed 75	2000	75

Link Distance (Length). This link attribute is automatically calculated when a node is moved or inserted, or a new link is added. This model uses the Washington State Plane coordinate system and has the scale integral to the model file. All lengths can be recomputed if desired using standard VISUM procedures.

Link Speed (MPH). With this update, the link speed is not automatically over-written from the Link Type value, so specific speeds can be used for links using special speed controls or traffic calming. Different speeds can be entered directionally.

Link Volumes. These are automatically computed with a model run and cannot be edited by the user.

Link Travel Times. These are automatically computed with a model run and cannot be edited by the user.

Count_2011. Traffic counts from 2011 are coded using User Defined Attributes (UDA). Where multiple counts were available these were entered in the field of Count_2_2011. Count location identification information is coded in Count_2011_ID and Count_2_2011_ID.

Model_2011. Model volumes for the calibrated and validated 2011 model run were saved in this field. These are used for post-processing volumes for further analysis.

Link-based delay is calculated during assignment from the assigned directional volumes on the link, the directional link capacity, according to the link delay formula for the link type. The delay formula is incorporated in the model run parameters file for each of the link types, similar to the previous TMODEL2 implementation. This delay is different for each direction on the link, to the extent that the directional volumes and possibly capacities are different. It is meant to account for running delays on links that arise due to volume, without consideration of intersection control delays.

Node-based delay is calculated during assignment from the assigned volumes through the node at the destination end of each directional link, that node's capacity and other delay features from the node impedance settings in the model run parameters file. These are automatically computed during the model run. Node delay is referred back to each approach leg so that total travel times through the network are accounted for correctly. The amount of node-based delay is often quite different for the two directions of a link because the nodes at opposite ends of the link are quite different.

NODE INVENTORY DATA CODING

In VISUM, like the previous implementation in TMODEL2, and unlike most other traffic modeling software, nodes are coded with data to precisely specify the delay characteristics of each node. This gives considerable power to simulate urban intersection behavior, and especially to model the different capacity, delay, and priority provided by signals, stop signs, roundabouts, interchanges, etc. In a local-area street network, the majority of delay is generated at intersections, rather than on links, so node coding is a powerful tool to improve assignment accuracy.

Automatic Node Coding. Due to the simplicity of the North Bend network, this feature was not utilized. Instead, all nodes of each given type were assigned a uniform capacity. The node coding values for all categories of intersection control and intersection channelization options are given in Table D-2.

Node Type (Intersection Control Type). The node type field defines the intersection control type for delay purposes and is matched to the node volume/delay functions used during the model run. Node types include all "real" intersection and interchange control options, and also "dummy" node categories representing non-intersections that are junctions of two or more links. These include "shape nodes" used to visually shape a curved road section using straight-line segments, and zone centroids which are preferably not also road intersections.

Intersection Control. This selection is not used for model run computations or delays. However, the specifications here will determine which analysis method is used for LOS computations. This field value only needs to be set for those locations that also have the **Analysis_Intersection** box checked, which specifies the locations to be analyzed. Analysis intersections must have detailed geometry and signalization coded for proper LOS analysis.

Node Capacity. This major attribute of every node is based on the Type field and this is automatically updated during the model run using the values in Table D-2. An additional amount of 500 per lane capacity is added for intersections with more than 4 entering lanes as per the previous TMODEL2 model.

TMODEL Special. This check box for approach links that have partial stop control must be checked to properly assign delay. To the legs that are stopped. When testing the conversion of a partial way stop controlled intersection to a roundabout or signal, confirm that none of the links approaching the intersection have this box checked. When this box is checked, VISUM allocates the calculated delay for the node to each such link, and assigns no delay to any other links entering that node. If the approach delay is to be allocated evenly to all approaches to an intersection, then TMODEL Special approach link boxes should be specified.

Count_ID. The name of the count location is identified when there are turn movement counts at this intersection.

Table D-2: Node Coding Values
City of North Bend Traffic Model
Node Coding Table

Type	Description	Capacity
0	Uncontrolled, Shape, Connector	32000
1	Two-Way Stop	1600
2	All-Way Stop	2000
3	Traffic Signal	3000
4	Roundabout	3600
5	Ramp - Merge	Outbound Link Capacity
6	Ramp - Diverge	32000

TURNS

Delay at intersections is further modeled in VISUM equations for specific turns at specific intersections; e.g., left turns. This is now incorporated directly in the model run file and a 6 second delay is added for all left turns. This represents the additional impedance that drivers perceive to make a left turn.

Count_2011. The volume of the turn count data for 2011 was entered in this field. This does not need revision for forecast runs.

Model_2011. The turn volume from the calibrated 2011 model was placed in this field for use in post-processing adjustments.

Adjustment. The amount of the adjustment for post-processing was automatically placed in this field and is automatically applied when conducting LOS analysis.

The case of absolute turn prohibition is coded by not allowing a Transport System (TSys) of Car to use the prohibited turn. If testing revisions where either placing or removing prohibitions, make sure and check that these are properly set.

CALCULATION OF DELAYS DURING ASSIGNMENT PROCESS

In the traffic assignment process, link, node, and turn delays are calculated based on the traffic volumes served and the coded capacity values. The calculation depends on the classification of the link, node, and turn, as well as the capacity. Delay on freeways thus accumulates by a formula that is different from the delay on arterials, or on local streets. Similarly, node delay is developed differently for signalized intersections than for stop controlled intersections.

A specific delay formula is defined for each type of link or node in the integral model run parameters. In the previous North Bend WA Traffic Model, only the node delays were defined with links using the default BPR volume-delay function. This is updated to use more realistic delay equations for both links and nodes with this 2011 update. During the assignment process, each link's and node's delay is calculated between iterations based on the ratio of demand volume to capacity. Each node's delay is calculated from the sum of entering volumes divided by capacity, and added to those approach legs which are specified to receive delay. No delay is added to the through (non-stopped) approach legs at partial stop controlled intersections. In cases of equal priority (all-way-stop, roundabouts, and signals), all approaches receive the same delay per vehicle. The resulting total travel time is updated for each iteration of the assignment. After the final assignment is completed, the resulting travel time is recorded for both the link and individual turns for each node. This can be converted to congested speed and/or to vehicle-hours of travel for reports, as desired.

TRIP GENERATION PROCEDURE BASED ON LAND USE DATA

To accurately simulate travel in the afternoon peak hour at residential locations, at employment sites, and at retail and service centers, the model accounts for each travel purpose that has different proportions of travel by trip *direction* and different patterns of trip *length*. These trip purposes include commuting between work and home, non-work travel between homes and other places, non-home-based travel including business travel, trucks and taxis, and personal travel between various locations excluding the home.

To improve the local accuracy of traffic simulations, the North Bend WA Traffic Model includes specialized trip purposes to also address trip chaining (a home-bound commuter's shopping or other intermediate stops between work and home). Trip generation for North Bend, WA Traffic Model followed the TMODEL2 "Type 2" method of trip generation in terms of data format and computations. This process was imported into VISUM and updated to use the integral trip generation procedure. Land use data for all zones is now saved directly in VISUM as data attributes for each TAZ. This allows for easy entry/edit and checking as well as graphical display. Trip generation rates are described for the afternoon peak hour in the model run procedures. There is no longer a need to use an external Excel workbook with the resultant complexity of use to import and export data. Land use categories and trip generation rates are the same as those used and previously calibrated.

1. **Land Use files**. Land Use categories used in North Bend, WA Traffic Model are as follows:

(a) Single-family dwellings (includes duplexes and conceivably condominiums, if large with multiple bedrooms and multiple parking stalls)
(b) Multi-family dwellings (apartments and most condominiums)
(c) General retail buildings (1,000 square feet gross floor area)
(d) General office buildings (1,000 square feet gross floor area)
(e) Industrial buildings (1,000 square feet gross floor area)
(f) Warehouse buildings (1,000 square feet gross floor area – industrial type activity but very low trip generation)
(g) Hotel and Motel buildings (1,000 square feet gross floor area)

(h) Medical-dental offices and hospitals (1,000 square feet gross floor area)
(i) Congregate Care facilities (1,000 square feet gross floor area – nursing homes, assisted living, etc. with full-time caretaker staff and limited off-site travel by residents)
(j) Park/ride lots (parking spaces)
(k) "Active" undeveloped land area (parks, playgrounds, utility storage areas – equivalent peak hour trips manually estimated for each such location)
(l) Special Land Uses (1,000 square feet – as inventoried from GIS source but not used in trip generation)
(m) Parking (1,000 square feet – as inventoried from GIS source but not used in trip generation)
(n) Vacant (1,000 square feet - as inventoried from GIS source but not used in trip generation)
(o) Open Space (1,000 square feet - as inventoried from GIS source but not used in trip generation)

The 2011 base year land use files were developed by first interpolating the previous data to estimate year 2011. These data elements were then checked and revised by the City of North Bend to update to current conditions and to also update the forecast values. Because the checking process involved some aggregation of categories, these were then disaggregated after the adjustment process to obtain the appropriate number of units for each TAZ.

Note that the inventory includes some categories not used for trip generation per se, but possibly useful to help allocate future growth assumptions from a citywide estimate to a subarea and zone level. These include the categories for "Special", "Vacant", and "Open Space", which may indicate future development potential. These were not updated nor revised during this model update process as they were not used for trip generation and did not affect model operation.

2. **Maintain Zone Attribute Data.** The average trip generation rates are sometimes modified according to zone-specific details, to account for unusual or non-average trip generation conditions at specific zones. The traffic modeler can use these zone attributes to account for traffic factors not addressed by the average trip generation rates in the model, and land use details not represented by the land use source data. The Zone Attribute page of the previous LUTG workbook held these factors and they were used in the trip generation spreadsheet. These factors were imported into the VISUM model as Zone (TAZ) attributes and used within the expanded trip generation process to replicate the earlier manual process. This is now automatic during the model run. The North Bend model adjustments included in the zone attributes include the following:

a. the Nintendo Factory is a large employer, but the shift schedule causes nearly all worker trip generation to occur before the afternoon peak hour, so trip generation is reduced to near zero by the non-residential trip generation intensity factor.
b. Some land use data from areas outside the City of North Bend was of uncertain accuracy. Where the rural residential environment supported a below-average trip rate the residential trip intensity factors were adjusted to .8 or .9 to best fit the available count data. For two zones the factor was raised to 1.1. This may also indicate inaccurate dwelling counts but there is no independent data to check.
c. Retail trip generation was adjusted to fit local conditions and specific retail activity characteristics. Many downtown North Bend zones have considerable walk-in business, and do

not generate vehicular trips at the level predicted by standard suburban trip rates such as provided by ITE. Each newly developed suburban-type retail zone was assigned an intensity factor of 1.0, but older established zones were given a factor of 0.4 because they were either walk-oriented or dominated by antiquated and uncompetitive businesses that do generate the level of vehicular activity suggested by the square footage in the GIS parcel inventory. These factors could be refined somewhat if more traffic count data were collected, but the value of the effort would be minimal in an overall sense.
d. The portion of a zone's retail activity that was freeway oriented, such as the Factory Mall zone, was given factors of to reflect the association of their trip generation with the freeway external zones, rather than distribute that trip generation within the city.

Two additional attributes are used in the distribution and assignment procedures. These were refined during the update of the model calibration with values that provided a better match for the traffic count data. They are:

a. Terminal Time gives the amount of time at the start and end of any trip to add to network travel time to account for the traveler's walk access time between a building and the vehicle. This is set uniformly at 50, representing 0.50 minutes, since all zones are small and the parking areas are immediately adjacent to homes and non-residential buildings in most cases.
b. Intrazonal Time was uniformly set to 9999 (representing 99.99 minutes) to assure that the gravity model does not assign any trips to start and end within the same zone. All zones are very small and intrazonal travel by vehicles is very small. This was revised to use 50% of the minimum time to the next two closest zones. This allows for some intrazonal trips for those situations with mixed use which reduces vehicle traffic on the roadway. Future year land use data and growth assumptions may or may not require that any zone attributes be changed. Changes should be made only for specific and documentable reasons.

3. **Calculate trip ends (origins and destinations) at each TAZ**.
The model run procedures, both for the base year and the forecast year contain procedures to compute the adjusted land use values and generate the trip ends for each TAZ. There is no manual intervention required. Trip generation for each trip purpose for each TAZ is calculated by direction, in terms of trip *origins* (leaving the TAZ) and trip *destinations* (entering the TAZ).

Note - Regional travel models commonly calculate trip generation in terms of *productions* and *attractions* at the *daily aggregate level* in a non-directional manner, and do not convert trips from that artificial schema to the more realistic origin/destination format until the final modeling step of traffic assignment. That complex procedure has been avoided in this model. Since peak hour travel has a highly directional character (as compared to daily travel that is generally balanced in both directions) it is more straightforward to use the form of origins and destinations directly at the trip generation stage. The trip generation rates have been correspondingly converted from productions and attractions to origins and destinations.

The traditional three major trip purposes represented in most regional traffic models are:

Home-based-work,
Home-based-other, and
Non-home-based.

The North Bend, WA Traffic Model further subdivides trip generation into a total of six directional "trip purposes" to more accurately describe peak hour travel. The additional trip purposes are used to subdivide trips by direction of travel, and to explicitly model "chained trips" involving more than one stop. The trip purposes used in this model are the following, all of which are directional in nature for better accuracy and control in the assignment process:

1. From Work to Home (no stops)
2. From Work to Other (first part of "chained" trips en route home; for shopping, etc.)
3. From Other to Home (concluding part of "chained" trips en route home)
4. From Home to Other (predominantly to retail shopping, and other local destinations)
5. From Other to Home (return part of local home-to-other trips)
6. Non-Home-Based (trips between two TAZ's which do not include the driver's residence. This accounts for several types of trips including second- or third- legs of a multi-stop tour of "chained" trips, commercial travel of all types, and truck travel.)

The Table D-3 lists the trip generation rates for this model's trip purposes, by land use type. The calibrated trip rates, when applied to the base year land use data, produce a balanced trip generation file in which the trip origins equal the trip destinations for each purpose, within a very small margin. The retail trip generation rate includes a significant size adjustment factor to account for scale effects. This factor is different for each zone, according to the amount of retail land use in that zone. The adjustments are applied before trips are generated.

Table D-3: Traffic Model Initial Trip Generation Rates

	A-WH		B-WK-DVT		C-DVT-HM		D-HM-OTH		E-OTH-HM		F-NHB	
Variable	Origins	Dests	Origins	Dests	Origins	Dests	Origins	Dests	Origins	Dests	Origins	Dests
SFDU	0.02000	0.29000	0.00000	0.00000	0.00000	0.07000	0.25000	0.05000	0.06000	0.25000	0.02000	0.01000
MFDU	0.00000	0.22000	0.00000	0.00000	0.00000	0.05000	0.14000	0.04000	0.04000	0.15000	0.01000	0.01000
Retail	0.05000	0.00000	0.00000	0.40000	0.40000	0.00000	0.00000	0.78000	0.77000	0.00000	0.71000	0.68000
Office	0.85000	0.00000	0.22000	0.00000	0.00000	0.00000	0.00000	0.11000	0.09000	0.00000	0.07000	0.13000
Industrial	0.49000	0.00000	0.12000	0.00000	0.00000	0.00000	0.00000	0.02000	0.02000	0.00000	0.04000	0.04000
Warehouse	0.02000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02000	0.02000	0.00000	0.01000	0.01000
Hotel	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.30000	0.30000	0.00000	0.30000	0.30000
Med_Dental	0.96000	0.00000	0.00000	0.41000	0.35000	0.00000	0.00000	0.91000	1.01000	0.00000	0.35000	0.41000
Congregate Care	0.07000	0.03000	0.00000	0.05000	0.05000	0.00000	0.00000	0.05000	0.05000	0.00000	0.00000	0.00000
Park & Ride	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.06000	0.00000	0.00000	0.10000	0.04000
X-I Origins	0.41515	0.00000	0.10217	0.00000	0.02728	0.00000	0.21224	0.00000	0.14525	0.00000	0.09791	0.00000
I-X Destinations	0.00000	0.13797	0.00000	0.02341	0.00000	0.03330	0.00000	0.33178	0.00000	0.11894	0.00000	0.35460

The previous model required a number of steps for to be conducted manually within the spreadsheet, such as balancing the trip origins and destinations. This is now automatically conducted in the model run procedures. However, the discussion is still included here for reference. When initially calibrated, the trip generation rates and the base-year land use are matched, so that total trip origins equal total trip destinations for each trip purpose. However, for future land use scenarios, the assumed future changes in land use within the local area and throughout the region usually do not constitute as precise a balance of homes and jobs as is true for the actual base-year conditions. As a result, the totals of computed future trip origins and trip destinations for each trip purpose will be unbalanced to some degree. The model procedures will balance these to the average of the total origins and destinations for all trips within each of the trip purposes.

ALTERNATIVE MODES

Travel by means other than cars and trucks is presently near-negligible throughout the modeled area centered on North Bend, WA., but the model can be revised for the future is these conditions change or it is desired to test large changes in use of alternative modes. This can be tested by either modifying trip generation rates, adding a factor, or adding a complete mode choice model into the model run parameters.

Park and Ride Lots

In addition to direct auto trip reductions attributable to local transit service, North Bend, WA Traffic Model also can simulate explicitly the automobile trips to/from park/ride lots in the study area. There are not existing park/ride lots of any size in North Bend today, but the land use file format contains a field to account for any such future lot. If park/ride spaces are coded into a TAZ for the future, the model will calculate the trips generated at the park/ride lot. The trip generation model calculates trip ends to and from each park/ride lot using a standard average driveway trip rate for park/ride lots in the region, as provided by Metro, the county transit operator. The regional average driveway trip rate is subdivided in this model into trip purposes to separately account for trips by direction between park/ride lots and homes, and between park/ride lots and nearby retail/commercial locations. This level of sophistication is needed to explain the fact that about 20% of activity at the park/ride lot in the afternoon peak hour is *inbound* not *outbound*, and that it takes approximately two hours of the afternoon peak period to fully discharge the park/ride lot's volume of parked cars.

The model assumes that each park/ride space that exists will be used with no substantial vacancies (but a vacancy factor could be established if needed as a unique Zone Attribute or as a reduced number of spaces). It is important therefore to accurately identify the timing and certainty of each potential future park/ride site. Park/ride lots tend to increase traffic volumes within the local area, but reduce them regionally. Lots located along state highways at the edges of the modeled local area do not actually reduce trips from the local area itself. Rather, they remove travel from roads further away from the local area. To reduce traffic impacts on a suburban area's major commuter arterial routes by such means, it is necessary to place significant park/ride facilities near the center of the local area, and to combine them with high quality transit service to/from the external employment areas.

TRIP DISTRIBUTION PROCEDURE

The output of the trip generation model is a table of trip generation for each TAZ, for each trip purpose. Each actual trip has two ends, which are both accounted for in trip generation. Trip origins leave a TAZ, while trip destinations arrive at a TAZ. The directionality of each trip purpose is important to the accurate modeling of peak hour traffic.

Example: A residential TAZ has many work-commute trip destinations in the afternoon, and few work-commuter trip origins (e.g., afternoon/evening-shift workers going to work). An employment location has many work commute trip origins in the afternoon peak hour, and few commute trip destinations. For shopping trips and most other trip purposes, the origins and destinations are roughly in balance at each TAZ, both residential and commercial.

The trip distribution model combines the trip generation information at all TAZs with mathematical formulae describing the length of all trips in the form of a probability distribution. Trips for each trip purpose will range from very long to very short, according to a calibrated probability curve which varies by trip purpose. Work-commute trips are much longer on average than other trip types. The trip length probability curves in North Bend, WA Traffic Model were taken from previously calibrated traffic models in other locations, and work well in this situation also. During the model import and update process, these were adjusted slightly to calibrate the model with the slightly different methodology and algorithms available in VISUM versus TMODEL2. Trip "length" in the trip distribution model can be measured as a weighted average of (predominantly) travel time and (modestly) travel distance between each pair of TAZ's. This composite measure is called the interzonal *impedance*. The coded road network is used to develop the matrix of interzonal times and distances, and combine those values into measures of time, distance, or weighted impedance between each pair of zones.

Congestion obviously affects travel times, and the existence or absence of major new road facilities can also affect these calculations. Therefore, the road network used to develop the trip distribution should be the same, or nearly the same, as the network to which trips are assigned in the last step of the model. To assure that this is so, North Bend, WA Traffic Model now uses an iterative feedback loop with weighted averaging based upon current research for model convergence. What this means is, for the first step, trips are distributed based upon free flow travel times, then for each iteration, the travel times are updated using a weighted average of the times from the previous iteration and the current iteration to adjust the trip distribution. After each update of the trip distribution, the trips are assigned to the network and the travel times are updated. This iterative process continues for ten (10) iterations or until the link volumes no longer are changing. This assures that the trip distribution reflects the congestion in the network. The gravity model coefficient values used for the TMODEL Gravity Model formulation in VISUM are shown below in table D-4.

Table D-4: Gravity Model Coefficients

Purpose	a	b	c
A-WH	-0.5	2.0	25
B-WK-DVT	-0.5	2.0	25
C-DVT-HM	-0.5	2.8	25
D-HM-OTH	-0.5	2.8	25
E-OTH-HM	-0.5	2.8	25
F-NHB	-0.5	2.9	25

The result of the trip distribution step is a trip table for each trip purpose, and these are combined a total trip table combining all trip purposes, for the afternoon peak hour. These trip tables can be examined and interpreted to help understand the movements that make up the travel patterns on the road system, and to devise effective future improvements, including multi-modal strategies. For example, analysis of the work-commute trip table can identify major clusters of commuters who might be attracted to an express bus service between North Bend, WA neighborhoods and employment centers elsewhere.

TRIP ASSIGNMENT PROCEDURE

The trip assignment procedure is updated to use the equilibrium assignment algorithm. This procedure minimizes travel time between all zone pairs, so it assumes that no traveler can change the path of their trip without increasing travel time for all travelers. This, of course, assumes that travelers have ideal knowledge of travel conditions throughout the network and will act logically on this knowledge to help optimize the system for themselves and all other travelers. In actuality, neither of the assumptions is true. However, this methodology gives us logical, rational, repeatable results. These results can then be used to test different alternatives. We have already discussed calibration and post-processing adjustments that may account for differences. However, we must first have a systematic repeatable approach that can be applied for the forecasts.

The trip tables produced by the trip distribution model are provided to the trip assignment model, for assignment to the road system. During each assignment iteration travel times are recomputed using the assigned traffic volumes, network input values for speed, capacity, and length, along with the volume delay functions to reflect congested travel times. As discussed in the section for trip distribution, the distribution and assignment use an iterative procedure to achieve an equilibrium state, both within the trip distribution and within the traffic assignment.

The final assignment uses Multi-Point Assignment, which is another TMODEL2 innovation that is used in VISUM now as well. This forces trips to use multiple TAZ centroid connectors to better reflect the arrangement of driveways, parking lots, and other access points within the TAZ. This has been proven to better reflect reality and to provide a better, more realistic, traffic assignment. The final equilibrium assignment is run to a converged relative gap statistic of 10^{-5}. If final assignments are not run to this low of a relative gap, the comparison of alternatives can lead to incorrect conclusions because the amount of random variation can exceed the amount of difference between alternatives. Insuring that the assignment is converged along with the convergence of the trip distribution assures that the model is responsive to the changes in the network.

MODEL VALIDATION

No traffic model is ever totally accurate, due to the practical limitations of input data (incomplete or inaccurate counts, land use, road network data, etc.) as well as the complexity and diversity of human travel decisions. *Calibration* of a traffic model consists of adjusting internal formulae and parameters to achieve a good representation of actual base year traffic from the inputs of base year land use and road data. *Validation* is the process of comparing traffic model outputs to traffic counts and other data, to verify reasonable operation according to available standards of reference.

This traffic model has been compared to three commonly accepted statistical standards suggested by the Federal Highway Administration, in Model Validation and Reasonableness Checking Manual (1997). These standards are advisory rather than mandatory, but are well-regarded by most transportation modelers.

R-Squared (R^2). This correlation statistic describes the "goodness of fit", or the overall degree to which the model volumes correspond to observed count data. Perfection would be 1.00 or

100% correlation of model volumes to counts. Values above 0.88 are desired. The updated North Bend model has a value of 0.89.

Slope of regression line. Although not specified in documentation, the R2 statistic can be within standards and the model will still not be representative of the count data and travel patterns unless the regression line has a slope of close to 1.0. There is not a standard for this value, but the updated North Bend model has a slope of 0.99.

Root-mean-square error (%RMSE). This describes the average model error in relation to the average counted volume and represents the spread from the regression line. Values under 35% are desired. The updated North Bend model has a value of 28%.

Allowable errors. A federal research study (National Academy of Sciences - Transportation Research Board, National Cooperative Highway Research Project #255, Highway Traffic Data for Urbanized Area Project Planning and Design, 1982). provides a well-known formula for allowable differences between model volumes and counts. The formula permits higher percentage errors on low-volume roads and lower percentage errors on high-volume roads. Obviously, the consequences of forecasting error will be greater on major roads. A high percentage of links with modeled volumes within this allowable range is obviously desirable, but no absolute standard is provided. It is recommended that 75% of links classified as Principal Arterial and above are within these limits. The updated North Bend model has 92% of ALL counted links within these limits.

These statistics show that the updated North Bend, WA Traffic Model is calibrated to an acceptable level to be used for forecasts.

MODEL RUN PROCEDURES

The PTV Vision VISUM version (.ver) files are supplied to the City for future use. All filter and other files are included with these files. There are three model run parameter (.par) files to be used for running the model.

North Bend Model Run 06082011.par – This file should be loaded for re-running base year calibration or validation if the network or land use is changed.

North Bend Forecast Run 10072011.par – This file should be loaded for running additional forecast alternatives if the network or land use is changed.

North Bend Intersection LOS 06082011.par – This file is loaded and used to run intersection LOS after one of the two procedures have been run. This will result in an excel spreadsheet being created that contains details on each intersection analyzed and a summary sheet showing the average and worst turn LOS.

APPENDIX E: Previous Plans and Studies

To: Ron Garrow, Public Works Director
Gina Estep - Planning Director

From: Kris Liljeblad, Project Manager

Date: November 3, 2011

Re: North Bend Transportation Comprehensive Plan Update;
Summary of Relevant Permitting and Other Resource Materials

The following materials were obtained and reviewed and pertinent information is summarized below:

- *North Bend Gravel Operation Final EIS*, Appendix M – Transportation Technical Report, URS, December 2001
- *WSDOT Truck Parking Study* – Final Report, prepared for WSDOT by Parametrix, December 2005
- *Middle Fork Business Park* - SEPA DNS and MDNS, King County DDES: October 20, 2000; November 4, 2002; and July 9, 2008
- *Middle Fork Road Re-Paving Project*, contacted by Michael Traffalis, FHWA; June, 2011

North Bend Gravel Operation Final EIS – This comprehensive analysis documented the traffic associated with the planned or "pipeline" land use changes in the vicinity including elementary and middle schools of 550 and 600 students respectively, the Genie warehouse/office development, two churches and 137 single family residences . Background traffic was assumed to grow in the school campus area at a rate of 2.5% per year. Documented existing operational issues were the lack of shoulders and turn lanes along 468th Avenue SE, limited sidewalks and street lights, truck queuing onto northbound 468th Avenue SE due to consecutive arrival to enter the Seattle East Auto Truck Plaza or to use the Pacific Pride fueling bays, and trucks passing on the shoulder to get around the queues. Existing traffic was found to be operating at LOS B or better conditions along 468th Avenue SE except at the I-90 EB ramp intersection, where LOS C was documented in the PM peak hour. Projected No Action PM peak hour operating conditions for the 468th corridor were to reach LOS F by 2015 at the intersection of 468th and the I-90 EB ramps, and by 2025 at the intersections of 468th/Middle Fork Road, 468th/146th, 468th/SE North Bend Way, and 468th/I-90 EB ramps. The added trip generation for the project is 998 trips per day in the peak month, and 25 trips during the PM peak hour, or approximately one trip every 2 minutes. All project trips would use I-90 via Exit 34, 468th Avenue SE to SE 146th Street, and SE 146th to the site. The additional truck traffic would make the already projected LOS F conditions worse in 2025, and also add to safety concerns for all users along the corridor. Recommended mitigation measures included widening 468th to 3-lanes from I-90 through the intersection of SE 146th Street, installing a traffic signal at the SE 146th Street/468th Avenue SE intersection (which did not meet warrants but reduced projected queue lengths), installation of 8-foot shoulders and continuous illumination, improving signage and pavement markings, installing a traffic signal in the future at the 468th Avenue SE/I-90 EB off-ramp intersection, and continuously monitoring future traffic conditions along the 468th corridor between I-90 and SE 144th Street.

WSDOT Truck Parking Study – The study analyzed the adequacy of truck parking along WA State's primary freight corridors including I-90, focusing on public rest areas, commercial truck stops, weigh stations and other unofficial areas (like chain-up areas). Findings relevant to North Bend included:

- The parking capacity in the west segment of I-90 between Seattle and Vantage is less than the demand, resulting in 39 to 90 illegally parked trucks on an average night.
- The Seattle East Auto/Truck Plaza in North Bend is regularly at capacity (about 94%) on an average night.
- The assumed growth in truck parking demand along the I-90 corridor is 4% per year.
- The resulting projected 2030 nighttime truck parking demand for the Seattle East Auto/Truck Plaza is 443 spaces compared to the existing supply of 175 (253% greater).
- Recommended ways to increase truck parking included constructing new public rest areas and limited feature lots for trucks, legalized use of weigh stations, public-private partnerships at commercial truck stops including financial aid and shared-use agreements, efforts to separate truck and recreational parking areas, a communications program on corridor parking conditions, and more rigorous and uniform enforcement of existing truck parking laws.

Middle Fork Business Park - Documentation was provided for a series of SEPA environmental determinations for the phased development of the Genie Properties located at SE 144th St / 468th Ave SE, including a 167,000 s.f. industrial warehouse and office building in October 2000, a 2nd phase 134,200 s.f. warehouse and 33,600 s.f. office in November 2002, and a 150,000 s.f. manufacturing/warehouse and 40,000 s.f. cross dock facility in July 2008. In addition to frontage improvements and mitigation fees, the applicant contributed a pro-rata share of $32,000 toward the cost of signalizing the intersection of 468th Avenue SE / I-90 eastbound on-off ramps to mitigate projected LOS F operating conditions. (The share represented 12.8% of an estimated $250,000 cost to signalize the intersection.)

Middle Fork Road Re-Paving Project – A contact call to King County's project manager was returned by Michael Traffalis of the Federal Highway Administration. He explained that the 9.7 mile re-paving project is a forest service project as it provides access to federal lands including the Mt. Baker Campground, forest service lands, and various mining claims. No logging is anticipated in the travelshed. King County has jurisdiction and maintenance responsibility. Traffic forecasts prepared in 2004 were provided. An annual growth rate of 1.5% was assumed, resulting in a 2011 ADT of 286 at MP 2.88 (nearest North Bend), increasing to 380 ADT in 2030.